FORTY-FIFTH ANNUAL REPORT

OF THE

New Jersey State Agricultural Experiment Station

AND THE

THIRTY-SEVENTH ANNUAL REPORT

OF THE

New Jersey Agricultural College Experiment Station

FOR THE YEAR ENDING JUNE 30

1924

Table of Contents

	PAGE
A. ORGANIZATION	xi
State Station	xi
Agricultural College Station	xii
B. LETTERS OF TRANSMITTAL	xiii
C. REPORT OF THE TREASURER	xv
State Station	xv
Agricultural College Station	xxix
D. REPORT OF THE DIRECTOR	1–18
New Types of Service	3
Research Projects	3
The College Farm	4
Publications	5
Bulletins	5
Circulars	5
Extension Bulletins	6
New Jersey Agriculture	6
Hints to Poultrymen	6
Report	6
Extension News Service	7
List of Available Publications	7
Journal Series	7
Research Projects	11
E. REPORT OF THE DEPARTMENT OF CHEMISTRY	19–44
I. Introductory	19
II. Administration	19
III. Inspection of Insecticides and Fungicides during 1923	20
IV. Inspection of Commercial Fertilizers during 1923	22
V. Inspection of Agricultural Lime during 1923	31
Summary of Results Obtained with Mixed Fertilizers	32
VI. Inspection of Commercial Feeding Stuffs during 1923	36
Summary of Results of the Inspection	42
F. REPORT OF THE DIVISION OF HORTICULTURE	45–103
Report of Department of Pomology	46
Spraying Experiments with Peaches	46
Spraying Experiments with Apples	50
Some Factors that Influence the Effectiveness of Peach Thinning	52
Small-Fruit Projects	58
Propagation and Distribution of Peach Seedlings	59
Experiments with Grapes	60

PAGE

Fruit Crop Conditions 60
Blooming Dates of Apples and Peaches 61
Blooming Dates of Small Fruits, 1924 65
Blooming Dates of Grapes, 1924 66
Report of Weather Observations 66
Peach Breeding Technical Phase—Project 4 70
Carnation Breeding—Project 9 73
Environmental Factors in Hydrangea Culture—Project 14 73
Culture Studies with Ornamentals—Project 22 74
Methods in Greenhouse *Propagation—Project 23* 75
Report of Vegetable Department 77
Plant-Food Studies with Tomatoes—Project 13 77
Plant-Food Studies with Sweet Potatoes—Project 14 77
Plant-Food Studies with Asparagus—Project 19 80
Muskmelon Studies—Project 20 84
Influence of Amount and Time of Applying Nitrate of Soda on Sweet Corn, Tomatoes and Peppers—Project 25 84
Miscellaneous Vegetable Studies in Northern New Jersey—Project 21 87

G. Report of the Department of Animal Husbandry 105–109
The Herd 105
Health of the Herd 105
Research Work 106
Hogging Down Corn Trial 108

H. Report of the Department of Poultry Husbandry 111–135
Acknowledgements 111
Publications 111
Service Program 112
New Jersey Egg-Laying Contests 113
New Jersey Poultry Exhibitions 115
Experimental Poultry Farm 115
The Research Program 116
A Group—Poultry Breeding 117
B Group—Poultry Pathology 119
Poultry Housing 133
Cold Storage Holdings 133
Poultry Nutrition Studies 133
Departmental Participation in World Poultry Affairs 135

I. Report of the Department of Dairy Husbandry 137–154
Departmental Activities 137
The Relation of the Ductless Glands to Milk Production—Project 13 137
Minimum Milk Requirement for Raising Dairy Calves—Project 6 146
The Effectiveness of Commercial Preservatives in Composite Milk Samples with Special Reference to Bichloride of Mercury—Project 17 146
The Effect of Mold Growth on the Butter-fat Test of Composite Samples—Project 18 147
Experiment to Determine Whether Alfalfa Meal When Fed to Dairy Cows Causes Garget—Project 19 147
Creameries Inspected 150

PAGE
Testers' Licenses 150
Weighers' and Samplers' Certificate of Approval........ 151
Permits to Purchase on the Butter-fat Basis 151
Inspection of Glassware 151
Prosecutions 152
Summary of Testing for the Year 1923-24 153
The Dairy Herd 153

J. Report of the Department of Seed Analysis 155–161
Administration 155
Seed Inspection 156
Official Samples 156
Unofficial Samples 156
Plant Identification 157
Legume Inoculation 157
Official Samples 158
Unofficial Samples 158

K. Report of the Extension Service 163–195
County Agent Work 165
County Boys' and Girls' Club Work 167
County Home Demonstration Work 168
Farm Crops Extension Work 170
Dairy Extension Work 174
Extension Work in Fruit Growing 179
Spraying 180
Organization 182
Vegetable Gardening Extension Work 183
Seed Selection 183
Veneer Bands 183
Transplanting of Plants 184
The Use of Selected Seed Tomato 184
Plant-Growing Structures 184
Melon Blight Control 184
Celery Blight Control 185
Eggplant Wilt Control 185
Cabbage Blackleg and Black Rot Control 185
Insect Control 185
Variety Standardization 186
Garden Machinery Demonstration for Vegetable Growers.... 187
Poultry Extension Work 187
Clothing Extension Work 189
Foods Extension Work 190
Breakfast Project 191
Meal Planning 191
Foods Budget 191
Home Management Extension Work 192
Agricultural Economics Extension Work 193
Farm Account Schools 194
Farm Account Clubs 195
Farm Account Analysis Schools 195

L. Report of the Department of Agronomy 197–232
Introduction 197
Potato Improvement 202
Alfalfa Strains 205

	PAGE
Adaptation and Yield Tests	205
Oats and Barley Variety Test	207
Timothy Variety Test	209
Annual Forage Crops	210
Soybeans	222
Miscellaneous	230
M. REPORT OF THE DEPARTMENT OF AGRICULTURAL ECONOMICS	233–235
Bulletins or Articles Published or in Printer's Hands	233
Extension Bulletins	233
Cost Accounts	234
Fruit Work	234
Poultry Project	235
Rural Life Project	235
N. REPORT OF THE DEPARTMENT OF BIOLOGY	237–246
I. Introduction	237
A. Condition of the Industry	237
B. The Station at Bivalve	237
C. The Floating Laboratory "Cynthia"	238
II. Weather and Water Conditions	238
III. Further Observations of the Abundance, Distribution and Setting of Oyster Larvæ	239
A. Barnegat Bay	239
B. Delaware Bay	242
C. The Mullica River	243
IV. The Nannoplankton as a Source of the Oyster's Food	243
V. Marine Borers	244
A. The Effects of the Type of Wood Upon the Shell Characters	244
B. Parasites of Teredo and of Bankia	245
Summary	245
References	246
O. REPORT OF THE DEPARTMENT OF SOIL CHEMISTRY AND BACTERIOLOGY	247–274
The Continuous Growing of Wheat and Rye with and without a Legume Green-manure crop—Season 1923	247
Crop of 1923	247
Percentage of Nitrogen in Grain and Straw for Fourteen Years	249
The Continuous Growing of Corn with a Legume and Non-Legume Green-manure crop—Season 1923	250
Comparison of Legume and Non-Legume Plots	252
The Influence of the Manure	252
Seven Years of Cooperative Fertilizer Experiments with Potatoes	252
The Influence of Lime on Soybeans	259
Influence of Sulfur Alone and in Combination with Rock Phosphate on Plant Growth	263
The Influence of Sulfur on Plant Growth	268
The Influence of Sulfur when Used in Combination with Manure	273
P. REPORT OF THE DEPARTMENT OF PLANT PHYSIOLOGY	275–277

PAGE

Q. REPORT OF THE DEPARTMENT OF ENTOMOLOGY 279–371
Introduction 279
Correspondence 280
Insects of the Year 280
Investigations 281
Mosquito Control 281
Climate and Insect Investigations 281
Orchard Insect Investigations 284
Codling Moth 284
Oriental Peach Moth 290
Oriental Peach Moth in the Season of 1923 291
Investigation of Dusts and of Stickers, Spreaders and Diluents for Spraying and Dusting Mixtures 295
Vegetable Insect Investigations 295
Further Observations on the Pepper Maggot During 1923 295
Some Chemicals Attractive to Adults of the Onion Maggot and the Seed Corn Maggot 298
Report of the Cranberry Substation 300
Investigation of the Biology of Sewage Disposal 305
Soil Infesting Insect Investigations 305
Bee Investigations 325
Introduction 325
The Relation of Honeybees to Fruit Growing 325
The Disappearing Disease 331
Breeding Bees 331
Report of Mosquito Work 350
Introduction 350
Investigations 350
Studies of Mosquito Repellants 350
Practical Work 353
Salt Marsh Drainage 353
Plans, Surveys and Inspections 362
County Work 366
Municipal Work 368
Prevalence of Mosquitoes During the Year 368
Correlation of Mosquito Commission Work 369
Educational Work 369
Work With Other Agencies 370

R. REPORT OF THE DEPARTMENT OF PLANT PATHOLOGY 373–421
Plant Diseases of the Year 1923 373
Alfalfa 373
Apple 374
Aster 374
Asparagus 374
Bean 374
Beat 375
Blackberry 375
Cabbage 375
Cauliflower 375
Cantaloupe 375
Cedar 375
Celery 375
Cherry 375
Chestnut 375
Chrysanthemum 376

PAGE

Clover 376
Corn 376
Cowpea 376
Cranberry 376
Cucumber 376
Currants 376
Dahlia 376
Eggplant 377
Gladiolus 377
Gooseberry 377
Hollyhock 377
Horse Chestnut 377
Horse Radish 377
Lilac 377
Lettuce 377
Oats 377
Parsley 377
Pea 378
Peach 378
Pear 378
Pepper 378
Plum 378
Potato 378
Quince 379
Raspberry 379
Rose 379
Rhododendron 380
Snap Dragon 380
Sunflower 380
Strawberry 380
Sweet Potato 380
Tomato 381
Watermelon 381
Wheat 381

Potato Spraying and Dusting in 1923 381
Tests With the Commercial Crop in Cooperation With J. H. Kandle, Elmer, N. J. 381
Spraying Test in Cooperation With I. B. Van Derveer, Freeholder 383
Test With Irish Cobblers 383
Test With the American Giant Variety 385
Test With the Norcross Variety 386
Spraying Tests With Late Crop Potatoes 387
Spraying Test in Cooperation With J. H. Kandle 388
Summary 389

Oats Smut Control Studies 390
Influence of Treatment on Germination 390

Sweet Potato Disease Studies 392
Pox or Ground Rot Disease Studies 393
Isolation Studies 395
Varietal Resistance 396
Studies on the Control of the Scurf, or Soil Stain Disease of Sweet Potatoes 396
Culture Reaction on the Growth of *Monilochaetes Infuscans* 398
Field Studies of the Control of the Scurf Disease of Sweet Potatoes 398

PAGE

Tomato Disease Studies 400
  Some Results of Spraying and Dusting Early Bonny Best Tomatoes 400
  Some Results of Spraying and Dusting Greater Baltimore Tomatoes 401
  Hail Injury and Tomato Rots 402
Pea Root Rot Studies 403
  Associated Organisms 404
  Pathogenicity Tests 405
  Influence of Soil Moisture and Soil Type on Root Rot 406
  Age of Plant and Susceptibility 409
  Influence of Repeated Planting 410
  Influence of Fertilizer, Lime and Sulfur Applications 410
  Planting Depth 412
  Resistant Strains Test 412
Potato Scab Control Studies in 1923 414
  Experiment in Cooperation with Elbert Newkirk, Bridgeton, Irish Cobbler Variety 415
  Experiment in Cooperation with John Hickish, Salem, N. J., Irish Cobbler Variety 417
  Experiment in Cooperation with Jacob Lopatin, Freehold, N. J., Giant Variety 420

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS*

NEW BRUNSWICK, NEW JERSEY

STATE STATION, ESTABLISHED 1880
BOARD OF MANAGERS

His Excellency GEORGE S. SILZER.....Trenton, Governor of the State of New Jersey
JACOB G. LIPMAN, PH.D..........Dean of Agriculture of the State Agricultural College

County	*Name*	*Address*
Atlantic	William A. Blair	Elwood
Bergen	Arthur Lozier	Ridgewood
Burlington	R. E. Lippincott	Vincentown
Camden	Ephraim T. Gill	Haddonfield
Cape May	Chas. P. Vanaman	Dias Creek
Cumberland	Chas. F. Seabrook	Bridgeton
Essex	C. A. Pfitzenmeyer	Caldwell
Gloucester	Wilbur F. Beckett	Swedesboro
Hudson	John Mehl	Jersey City
Hunterdon	Egbert T. Bush	Stockton
Mercer	J. W. Hendrickson	Ewingville
Middlesex	James Neilson	New Bruns'k
Monmouth	William H. Reid	Tennent
Morris	John C. Welsh	Long Valley
Ocean	James E. Otis	Tuckerton
Passaic	Raymond G. Buser	Paterson
Salem	Charles R. Hires	Salem
Somerset	Joseph Larocque	Bernardsville
Sussex	Thomas C. Roe	Augusta
Union	John Z. Hatfield	Scotch Plains
Warren	Thomas A. Shields	Hackettstown

STAFF

JACOB G. LIPMAN, PH.D..........Director
F. ARTHUR HALL, B.SC..........Assistant to the Director
IRVING E. QUACKENBOSS........Chief Clerk, Secretary and Treasurer
RUSSELL E. LONG...............Senior Clerk
HARRIET E. GOWEN.............Chief Stenographer and Clerk

H. G. BAILEY..Foreman Vegetable Gardening
GEORGE I. BALL........Creamery Inspector
JOHN W. BARTLETT, B.SC., Dairy Husbandman
F. R. BEAUDETTE, D.V.M., Poultry Pathologist
CHAS. S. BECKWITH, B.SC., Assistant Entomologist
F. S. BECKWITH, B.SC., *Fertilizer and Feed Sampler*
J. W. BELLIS...............Farm Manager
CARL B. BENDER, M.S., Assistant Dairy Husbandman
H. M. BIEKART....................Florist
JAMES J. BLACK, D.V.M..Poultry Pathologist
M. A. BLAKE, B.SC., Chief, Division of Horticulture
SADIE BOYCE.......Assistant Seed Analyst
FORREST BUTTON, B.SC., Assistant Dairy Husbandman
F. L. CAMPBELL, B.SC., Assistant in Sewage Invest.
CHAS. S. CATHCART, M.SC..........Chemist
R. CHAMBERLAIN, B.SC., Res. Assistant Dairy Husbandman
J. H. CLARKE, M.SC......Asst. Pomologist
FOREST H. CLICKNER, M.SC., Assistant Poultry Specialist
C. H. CONNORS, B.SC., Associate in Plant Breeding
ROGER W. DEBAUN, B.S....Assistant Editor
MARTIN DECKER.....Asst. Poultry Specialist
B. F. DRIGGERS, B.SC., Assistant in Cranberry Culture
LEO J. FANEUF, B.SC....Assistant Chemist
ARTHUR J. FARLEY, B.SC.......Pomologist
ANTHONY J. FISCHER, B.SC., Chemist, Sewage Investigations
JESSIE G. FISKE, M.SC.......Seed Analyst
B. R. FUDGE, B.S.......Asst. Seed Analyst
E. R. GROSS, B.SC..Chief, Rural Engineering
C. M. HAENSELER, PH.D., Assistant in Plant Breeding
JOHN G. HALL..Foreman, Egg Laying Contest
WILLARD S. HAMILTON, Foreman, Egg Laying Contest
R. R. HANNAS, M.SC., Supt. Egg Laying Contest
THOMAS J. HEADLEE, PH.D....Entomologist
FRANK G. HELYAR, B.SC., Animal Husbandman
G. W. HERVEY, M.A...Assoc. Poultry Husb.
MARGARET HOTCHKISS, PH.D., Bacteriologist, Sewage Investigations
HOWARD F. HUBER, B.SC., Assistant Olericulturist
R. HUTSON, B.SC....Assistant in Apiculture
CARL ILG..........Lab. Asst. Entomology
HENRY KELLER, JR., M.SC...Agr. Economist
J. B. LACKEY, M.A., Res. Zoologist, Sewage Invest.
WILLIAM H. MARTIN, PH.D., Plant Pathologist
HARRY C. MCLEAN, PH.D..Soil Bacteriologist
G. W. MUSGRAVE, M.S..........Agronomist
THURLOW C. NELSON, PH.D.......Biologist
GEORGE A. OSBORN, A.M.........Librarian
ALVAH PETERSON, PH.D..Asst. Entomologist
ROBERT F. POOLE, PH.D..Assoc. Plant Path.
W. R. ROBBERS...Supt. Advanced Registry
T. C. ROGERS, B.SC., Res. Assistant in Horticulture
WILLEM RUDOLFS, PH.D., Biochemist in Ento., Chief of Sew. Invest.
LYMAN G. SCHERMERHORN, B.SC., Olericulturist
W. C. SKELLEY, M.SC., *Assistant Animal Husbandman*
ELIZABETH G. SKILLMAN, B.SC., Asst. Librarian
L. R. SMITH, B.SC.......Assistant Chemist
LOUIS A. STEARNS, M.S..Asst. Entomologist
CLARENCE H. STEELMAN...Orchard Foreman
JOHN THOMPSON.........Swine Herdsman
W. C. THOMPSON, B.SC., Poultry Husbandman
WILBUR N. WALDEN.....Asst. Entomologist
ARCHIE C. WARK........Assistant Chemist
RALPH L. WILLIS, B.SC..Assistant Chemist
CARL R. WOODWARD, A.M..........Editor

Staff list revised to August 15, 1924.

AGRICULTURAL COLLEGE STATION, ESTABLISHED 1888

BOARD OF CONTROL

The Board of Trustees of Rutgers College in New Jersey

EXECUTIVE COMMITTEE OF THE BOARD

W. EDWIN FLORANCE..New Brunswick
WILLIAM H. LEUPP..New Brunswick
WILLIAM S. MYERS..New York City
JAMES NEILSON..New Brunswick
ALFRED F. SKINNER..Newark

STAFF

JACOB G. LIPMAN, PH.D.............Director
F. ARTHUR HALL, B.Sc...............Assistant to the Director
HENRY P. SCHNEEWEISS, A.B.........Chief Clerk

A. W. BLAIR, A.M...Associate Soil Chemist
J. G. GAINES, B.Sc..Res. Asst. in Plant Path.
J. M. GINSBURG, M.Sc., Res. Asst. in Plant Physiology
THOMAS J. HEADLEE, PH.D....Entomologist
JACOB S. JOFFE, PH.D., Res. Asst., Microbiology
CARL D. JONES, M.Sc....Res. Asst. in Soils
J. G. LIPMAN, PH.D., Soil Chemist and Bacteriologist
H. C. MCLEAN, PH.D....Soil Bacteriologist
AUGUSTA E. MESKE..Stenographer and Clerk
ALVAH PETERSON, PH.D..Asst. Entomologist
A. L. PRINCE, M.Sc......Assistant Chemist
W. R. ROBBINS, M.Sc., Res. Asst. in Plant Physiology
JOHN W. SHIVE, PH.D...Plant Physiologist
S. A. WAKSMAN, PH.D., Microbiologist, Soil Res.
CLARA H. WARK, Laboratory Asst. in Soil Bact.

EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS ORGANIZED 1912

STAFF

HERBERT J. BAKER, B.Sc., Director

W. H. ALLEN, B.Sc., Specialist, Poultry Husbandry
MRS. MARION C. BELL, B.S., Specialist in Home Management
ANNA C. BERGEN..............Chief Clerk
HELEN G. BISHOP, B.S., Assistant Specialist in Clothing
MARION BUTTERS, B.Sc., Home Demonstration Leader
H. R. COX, M.S.A., Specialist, Soil Fert. and Agron.
ROGER W. DEBAUN, B.S....Assistant Editor
MARIE C. DOERMAN, B.Sc., Specialist in Nutrition
MRS. C. H. GRIEBEL..Specialist in Clothing
A. M. HULBERT, State Leader, Junior Extension
M. ETHEL JONES, M.A., Asst. Leader, Junior Extension
W. F. KNOWLES, A.B..Specialist, Agr. Econ.
A. F. MASON, M.Sc., Specialist in Fruit Growing
C. H. NISSLEY, B.Sc., Specialist in Vegetable Growing
IRVING L. OWEN, B.Sc.....State Supt. and State Leader of Farm Demonstration
E. J. PERRY, B.S..Specialist Dairy Husb'dry
BERNARD F. RAMSBURG, B.Sc., Club Agent at Large
CARL R. WOODWARD, A.M...........Editor

COUNTY AGRICULTURAL AGENTS

County	
Atlantic	ARTHUR R. ELDRED, B.Sc.
	CHAS. CIANCIARULO, B.S., Assoc.
Bergen	W. RAYMOND STONE
Burlington	C. A. THOMPSON, B.Sc.
	LEONARD R. SMITH, B.S., Assoc.
Camden	SAMUEL F. FOSTER, B.Sc.
Cape May	W. COLLINS THOMAS, B.S.
Cumberland	F. V. D. CORTELYOU, B.Sc.
	CHARLES H. CANE, Assoc.
Essex	IRVIN T. FRANCIS, A.B.
Gloucester	GEORGE E. LAMB, B.Sc.
Mercer	AMZI C. MCLEAN, B.Sc.
Middlesex	ORLEY G. BOWEN, B.S.
Monmouth	ELLWOOD DOUGLASS
Morris	A. HOWARD SAXE, B.Sc.
Ocean	ERNEST H. WAITE, B.Sc.
Passaic	HAROLD E. WETTYEN, B.Sc.
Salem	JOHN C. CRISSEY, B.Sc.
Somerset	HARRY C. HAINES
Sussex	DOUGLAS A. EVANS, B.S.
Warren	HOWARD MASON, B.Sc.

Home Demonstration Agents

County	
Atlantic	MRS. EDITH G. NORMAN, B.Sc.
Bergen	MRS. M. B. WATSON, B.Sc.
	MRS. ELIZ. M. BERDAN, Asst.
Camden	EMILY KELLOGG, B.Sc.
Essex	K. EVELYN SLY, B.Sc.
Mercer	J. KATHRYN FRANCIS, B.Sc.
Middlesex	MAY TRUMAN, B.Sc.
Monmouth	MABEL E. SMITH, B.Sc.
Morris	KATHRYN HUNTER, B.Sc.
Passaic	MARGARET H. HARTNETT, B.S.
Somerset	CHARLOTTE EMBLETON
Sussex	ANNIE M. HOLBROOK
City of Paterson	MRS. CECILIA BROGAN

County Club Agents

County	
Mercer	JOSEPH B. TURPIN, B.Sc.
Middlesex	J. FOSTER F. PRICE, B.S.
Monmouth	D. M. BABBITT, B.Sc.
Morris	EDWIN A. GAUNTT, B.S.
Ocean	ELSIE R. HORNE, B.Sc.
Salem	F. J. GOGGIN, B.S.
Warren	L. W. HILL, B.Sc.

Letters of Transmittal

To His Excellency, George S. Silzer, Governor of the State of New Jersey:

SIR—I have the honor to submit herewith the Forty-fifth Annual Report of the New Jersey State Agricultural Experiment Station, as required by the law establishing the Station, which was approved March 10, 1880, and which is chapter 106 of the laws of that year.

JAMES NEILSON,
President.

NEW BRUNSWICK, N. J., July 31, 1924.

To His Excellency, George S. Silzer, Governor of the State of New Jersey:

SIR—In compliance with an act of Congress, approved March 2, 1887, and with an act of the Legislature of this State, approved March 5, 1888, I beg leave to submit, on behalf of the Trustees of Rutgers College in New Jersey, maintaining Rutgers Scientific School, the New Jersey State College, for the benefit of Agriculture and Mechanic Arts, the Thirty-seventh Annual Report of the operations of the Department of the College which has been organized in accordance with said act of Congress, and is known as "The State Agricultural College Experiment Station."

WILLIAM E. FLORANCE,
Acting President.

NEW BRUNSWICK, N. J., July 31, 1924.

Treasurer's Report

Irving E. Quackenboss, in account with the New Jersey State Agricultural Experiment Station, July 1st, 1923, to June 30th, 1924.

Appropriation for Salaries, Wages and Maintenance

Appropriation	$80,000.00
Collections from Dairy Department	12,532.35
Collections from Animal Husbandry Department	2,530.05
Collection of Feed Inspection and Registration Fees	27,102.71
Collection of Fertilizer Inspection and Registration Fees	24,926.71
Total	$147,091.82

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$88,565.68
Bills submitted to State Comptroller for direct payment—	
Books and Periodicals	268.66
Coal	1,660.50
Dairy Farmhouse Supplies	42.25
Electric Current and Gas	2,564.33
Express, Freight and Cartage	1,719.81
Feed and Shavings	19,065.53
Fertilizer	2,232.42
Grading, Repairs to Roads, etc.	152.05
Hardware, Tools, etc.	1,396.57
Ice	554.50
Insurance	296.12
Laundry Work	433.74
Live Stock	150.00
Miscellaneous Hour and Day Labor	7,631.85
Office Furniture and Equipment	40.00
Photographic Supplies and Blue Prints	249.75
Postage	805.95
Registration of Animals	67.75
Repairs and Alterations to Buildings	2,064.84
Repairs to Equipment	789.38
Road Sprinkler	112.70
Scientific Equipment	161.00
Scientific Supplies	1,688.76
Small Printing and Stationery	1,815.97
Telephone and Telegraph	2,601.75
Traveling Expenses	6,384.32
Trees, Seeds and Vines	338.54
Vehicular Transportation, Supplies, Repairs, etc.	1,769.50

Veterinary Services and Medicine	1,035.45
Sundries	190.48
	$146,849.95
Amount reverting to State Treasury	241.87
Total	$147,091.82

Appropriation for Printing Bulletins and Circulars

Appropriation	$15,000.00
Collections from Department of Publications	15.39
Refund for over-payment of bill	8.53
Total	$15,023.92

PAYMENTS

Bills submitted to State Comptroller for direct payment—	
For Printing Bulletins and Circulars	$14,997.41
Amount reverting to State Treasury	26.51
Total	$15,023.92

Appropriation for Abolishing Mosquito Breeding Salt Marshes

Appropriation	$18,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$8,681.66
Bills submitted to State Comptroller for direct payment—	
Ditching Unit, Accessories and Supplies	530.83
Express, Freight and Cartage	24.53
Field Supplies	99.97
Ford Coupe (Exchanged)	290.00
Labor and Material for Construction of Caterpillar Tractor,	2,165.64
Miscellaneous Hour and Day Labor	169.50
Photographic Supplies and Blue Prints	19.70
Postage	100.00
Repairs to Equipment	57.40
Small Printing and Stationery	148.28
Telephone and Telegraph	61.04
Traveling Expenses	1,336.18
Vehicular Transportation, Supplies, Repairs, etc.	667.46
	$14,412.19
Amount reserved by requisition until next fiscal year (Tractor),	3,444.00
Amount reverting to State Treasury	143.81
Total	$18,000.00

Appropriation for the Investigation of Oyster Propagation

Appropriation	$6,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$3,200.00
Bills submitted to State Comptroller for direct payment—	
Books and Periodicals	8.35
Coal	32.00
Electric Current and Gas	36.50
Express, Freight and Cartage	33.53
Insurance	42.50
Laboratory Equipment	459.35
Laboratory Supplies	459 00
Miscellaneous Hour and Day Labor	25.00
Photographic Supplies	10.40
Postage	12.22
Repairs to Equipment	427.85
Sea Skiff	750.00
Small Printing and Stationery	4.83
Storage of Boats	152.10
Telephone and Telegraph	38.45
Traveling Expenses	302.90
	$5,994.98
Amount reverting to State Treasury	5.02
Total	$6,000.00

Appropriation for the Department of Poultry Husbandry

Appropriation	$20,000.00
Collections for Sales of Poultry and Eggs	6,273.52
Total	$26,273.52

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$15,212.50
Bills submitted to State Comptroller for direct payment—	
Coal	265.00
Insurance	420.72
Miscellaneous Hour and Day Labor	737.40
Office Furniture and Equipment	96.97
Poultry Feed	5,652.75
Poultry Supplies and Tools	654.42
Poultry Stock	750.00
Repairs and Alterations to Buildings	946.98
Repairs to Equipment	322.00
Scientific Equipment	70.33
Scientific Supplies	625.20
Small Printing and Stationery	45.10
Traveling Expenses	399.97
Seed	54.25
Veterinary Medicine	7.25
	$26,260.84
Amount Reverting to State Treasury	12.68
Total	$26,273.52

Appropriation for Seed Inspection

Appropriation	$8,500.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	5,197.50
Bills submitted to State Comptroller for direct payment—	
Miscellaneous Hour and Day Labor	87.60
Office Furniture and Equipment	204.00
Photographic Supplies	22.20
Postage	650.00
Repairs to Equipment	61.00
Scientific Equipment	751.25
Scientific Supplies	149.83
Small Printing and Stationery	549.66
Traveling Expenses	473.95
Vehicular Transportation, Supplies, Repairs, etc.	212.17
Sundries	15.65
	$8,374.81
Amount reverting to State Treasury	125.19
Total	$8,500.00

Appropriation for Experimental Work in Vegetable Production

Appropriation	$3,000.00
Collections for Sales of Vegetables	117.96
Collections for Sales of Flowers	2,870.24
Total	$5,988.20

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$3,615.00
Bills submitted to State Comptroller for direct payment—	
Books and Periodicals	1.50
Coal	662.50
Greenhouse Supplies and Tools	242.62
Insurance	91.30
Miscellaneous Hour and Day Labor	858.06
Repairs and Alterations to Buildings	474.25
Seed	6.00
	$5,951.23
Amount reverting to State Treasury	36.97
Total	$5,988.20

Appropriation for Insecticide Inspection

Appropriation	$1,000.00

PAYMENTS

Bills submitted to State Comptroller for direct payment—	
Scientific Equipment	182.87
Scientific Supplies	808.25
	$991.12
Amount reverting to State Treasury	8.88
Total	$1,000.00

Appropriation for Farm Demonstration

Appropriation	$70,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	68,157.70
Bills submitted to State Comptroller for direct *payment—*	
Postage	68.19
Printing Circulars (*N. J. Agriculture*)	1,774.11
Total	$70,000.000

Appropriation for Cranberry Investigation

Appropriation	$5,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	3,950.00
Bills submitted to State Comptroller *for direct payment—*	
Express, Freight and Cartage	2.74
Miscellaneous *Hour and Day* Labor	167.00
Rental of Building for Research Laboratory	150.00
Telephone and Telegraph	60.30
Traveling Expenses	667.36
Vehicular Transportation, Supplies, Repairs, etc.	2.00
	$4,999.40
Amount reverting to State Treasury	.60
Total	$5,000.00

Appropriation for Egg-Laying and Breeding Tests

Appropriation	$10,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	7,485.00
Bills submitted to State Comptroller for direct payment—	
Poultry Crates and Coops	437.50
Poultry Feed	2,066.40
	$9,988.90
Amount reverting to State Treasury	11.10
Total	$10,000.00

Appropriation for Experimental Work in Growing White Potatoes, Sweet Potatoes and Tomatoes

Appropriation	$12,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$9,525.84
Bills submitted to State Comptroller for direct payment—	
Express, Freight and Cartage	4.67
Miscellaneous Hour and Day Labor	72.51
Scientific Equipment	130.41
Scientific Supplies	115.46
Telephone and Telegraph	6.70
Traveling Expenses	2,135.20
Vehicular Transportation, Repairs, Supplies, etc.	3.05
	$11,993 84
Amount reverting to State Treasury	6.16
Total	$12,000.00

Appropriation for Legume Inoculation Inspection

Appropriation	$2,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$1,207.50

Bills submitted to State Comptroller for direct payment—	
Legume Inoculant Samples	22.43
Scientific Equipment	638.94
Scientific Supplies	23.64
Small Printing and Stationery	23.00
Traveling Expenses	41.66
Vehicular Transportation, Repairs, Supplies, etc.	8.30
	$1,965.47
Amount reverting to State Treasury	34.53
Total	$2,000.00

Appropriation for Poultry Exhibitions and Premiums

Appropriation	$6,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$355.00
Bills submitted to State Comptroller for direct payment—	
Office Equipment	15.00
Premiums Awarded	5,458.45
	$5,828.45
Amount reverting to State Treasury	171.55
Total	$6,000.00

Appropriation for Sewage Investigation

Appropriation	$5,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$4,020.00
Bills submitted to State Comptroller for direct payment—	
Books and Periodicals	7.53
Express, Freight and Cartage	.55
Miscellaneous Hour and Day Labor	312.50
Postage	30.00
Scientific Equipment	225.83
Scientific Supplies	206.82
Telephone and Telegraph	42.95
Traveling Expenses	124.18
	$4,970 36
Amount reverting to State Treasury	29.64

Appropriation for Milk and Cream Inspection

Appropriation	$3,000.00
Collections for Testing Glassware and Testers' Licenses Issued	651.87
Total	$3,651.87

PAYMENTS

By Treasurer of the *Experiment Station*—	
Salaries and Wages	$2,272.50
Bills submitted to State Comptroller for *direct payment*—	
Scientific Supplies	3.50
Small Printing and Stationery	7.25
Traveling Expenses	1,322.66
	$3,605.91
Amount reverting to State Treasury	45.96
Total	$3,651.87

Appropriation for Investigation of Root Rot of Peas

Appropriation	$3,500.00

PAYMENTS.

By Treasurer of the Experiment *Station*—	
Salaries and Wages	$3,250.00
Bills submitted to State Comptroller for direct *payment*—	
Express, Freight and Cartage	.97
Miscellaneous Hour and Day Labor	8.40
Telephone and Telegraph	.50
Traveling Expenses	210.04
Seed	2.90
	$3,472.81
Amount reverting to State Treasury	27.19
Total	$3,500.00

Appropriation for Investigation of Bee Husbandry

Appropriation	$3,000.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$2,146.66
Bills submitted to State Comptroller for direct payment—	
Field Supplies	31.55
Miscellaneous Hour and Day Labor	13.28
Rental of Bees	75.00
Rental of Land for Apiary Site	20.00
Repairs to Equipment	11.15
Traveling Expenses	698.77
Vehicular Transportation, Repairs, Supplies, etc.	1.20
	$2,997.61
Amount reverting to State Treasury	2.39
Total	$3,000.00

Appropriation for Experimental Work in Vegetable Production in North Jersey

Appropriation	$2,500.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$1,850.00
Bills submitted to State Comptroller for direct payment—	
Fertilizer	23.90
Hardware, Tools, etc.	.75
Miscellaneous Hour and Day Labor	32.00
Photographic Supplies	5.05
Telephone and Telegraph	5.50
Traveling Expenses	436.32
Seed	81.29
Use of Farm Machinery and Team Hire	51.20
	$2,486 01
Amount reverting to State Treasury	13.99
Total	$2,500.00

Appropriation for Graphotype, Mimeograph, Folding Machine and Electroplate Cabinet

Appropriation	$1,200.00

PAYMENTS

Bills submittel to State Comptroller for direct payment—	
Office Equipment	$1,021.00
Amount reverting to State Treasury	179.00
Total	$1,200.00

Appropriation for Tractor and Tools

Appropriation	$750.00

PAYMENTS

Bills submitted to State Comptroller for direct payment—	
Tractor and Tools	704.70
Amount reverting to State Treasury	45.30
Total	$750.00

Appropriation for Ford Truck

Appropriation	$500.00

PAYMENTS

Bills submitted to State Comptroller for direct payment—	
Ford Truck (Exchange)	478.45
Amount reverting to State Treasury	21.55
Total	$500.00

Appropriation for Two Ford Touring Cars

Appropriation	$700.00

PAYMENTS

Bills submitted to State Comptroller for direct payment—	
Two Ford Touring Cars (Exchanged)	669.84
Amount reverting to State Treasury	30.16
Total	$700.00

Appropriation for Experimental Work with Small Fruits

Appropriation	$2,500.00

PAYMENTS

By Treasurer of the Experiment Station—	
Salaries and Wages	$2,300.00
Bills submitted to State Comptroller for direct payment—	
One Farm Wagon	200.00
Total	$2,500.00

Allotment from Emergency Fund for Installation of Boiler in Floriculture Greenhouse

Allotment	$1,145.00

PAYMENTS

Bills submitted to State Comptroller for direct payment—	
Installation of Boiler	$1,120.00
Amount reverting to State Treasury	25.00
Total	$1,145.00

Emergency Appropriation for Combating the Oriental Peach Moth

Appropriation		$3,500.00

PAYMENTS

By Treasurer of the Experiment Station—		
Salaries and Wages		$960.00
Bills submitted to State Comptroller for direct payment—		
Express, Freight and Cartage		89.97
Erection of an Insectary		485.00
Field Supplies		306.13
Ford Coupe		578.95
Miscellaneous Hour and Day Labor		59.93
Office Furniture and Equipment		68.00
Scientific Equipment		50.00
Small Printing and Stationery		4.05
Telephone and Telegraph		.40
Traveling Expenses		796.50
Vehicular Transportation, Repairs, Supplies, etc.		62.96
		$3,461.89
Amount reverting to State Treasury		38.11
Total		$3,500.00

SUMMARY

Total Appropriations and Allotment from Emergency Fund	$283,795.00
Total Collections Credited to Appropriations	77,020.80
Refund for Over-payment of Bill	8.53
Total	$360,824.33

Summary of Analysis of all Expenditures

Books and Periodicals	$286.04
Coal	2,620.00
Dairy Farmhouse Supplies	42.25
Electric Current and Gas	2,600.83
Erection of an Insectary	485.00
Express, Freight and Cartage	1,876.77
Feed and Shavings	26,784.68
Fertilizer	2,256.32
Field Supplies	437.65
Ford Coupe	578.95
Ford Coupe (Exchanged)	290.00
Ford Touring Cars (2 Exchanged)	669.84
Ford Truck (Exchanged)	478.45
Grading, Repairs to Roads, etc.	152.05
Hardware, Tools, etc.	3,636.56
Ice	554.50
Insurance	850.64
Labor and Material for Construction of Caterpillar Tractor	2,165.64
Laundry Work	433.74
Live Stock	900.00
Miscellaneous Hour and Day Labor	10,175.03
Mosquito Ditching Unit, Accessories and Supplies	530.83
Office Furniture and Equipment	1,444.97
Photographic Supplies and Blue Prints	307.10
Postage	1,726.36
Premiums Awarded Poultry Exhibitions	5,458.45
Printing Bulletins and Circulars	16,771.52
Registration of Animals	67.75
Rental of Building for Cranberry Research Laboratory	150.00
Rental of Land for Apiary Site	20.00
Repairs and Alterations to Buildings	4,606.07
Repairs to Equipment	1,668.78
Road Sprinkler	112.50
Salaries and Wages	231,952.54
Scientific Equipment	2,669.98
Scientific Supplies	4,102.89
Sea Skiff for Oyster Investigation	750.00
Small Printing and Stationery	2,598.14
Sundries	484.43
Telephone and Telegraph	2,817.59
Traveling Expenses	15,330.01
Trees, Seeds and Vines	482.98
Vehicular Transportation, Supplies, Repairs, etc.	2,726.64
Veterinary Services and Medicine	1,042.70
	$356,097.17
Amount reserved by Requisition-Tractor for Mosquito Field Work.	3,444.00
Amount reverting to State Treasury	1,283.16
Total	$360,824.33

Collections Account

RECEIPTS

From Dairy Department—	
Collections for Sales of Milk, Cream and Dairy Stock	$12,532.35
From Animal Husbandry Department—	
Collections for Sales of Swine	2,530.05
From Chemical Department—	
Collection of Fertilizer Inspection and Registration Fees ...	24,926.71
From Chemistry Department—	
Collection of Feed Inspection and Registration Fees	27,102.71
From Department of Publications—	
Collection for Sales of Bulletins and Circulars	15.39
From Poultry Department—	
Collections for Sales of Poultry and Eggs	6,273.52
From Floriculture Department—	
Collections for Sales of Flowers	2,870.24
From Vegetable Gardening Department—	
Collections for Sales of Vegetables	117.96
From Dairy Department—	
Collections for Testing Glassware and Testers' Licenses Issued,	651.87
From National Bank of New Jersey—	
For Interests on Deposits	130.26
Total	$77,151.06

PAYMENTS

To State Treasurer—	
Collections for Sales of Milk, Cream and Dairy Stock	$12,532.35
To State Treasurer—	
Collections for Sales of Swine	2,530.05
To State Treasurer—	
Collection of Fertilizer Inspection and Registration Fees ..	24,926.71
To State Treasurer—	
Collection of Feed Inspection and Registration Fees	27,102.71
To State Treasurer—	
Collections for Sales of Bulletins and Circulars	15.39
To State Treasurer—	
Collections for Sales of Poultry and Eggs	6,273.52
To State Treasurer—	
Collections for Sales of Flowers	2,870.24
To State Treasurer—	
Collections for Sales of Vegetables	117.96
To State Treasurer—	
Collections for Testing Glassware and Testers' Licenses Issued,	651.87
To State Treasurer—	
For Interest on Deposits	130.26
Total	$77,151.06

The Auditing Committee of the Experiment Station has examined the Accounts of the Treasurer of said Station, and has found them correct.

(Signed) WM. H. REID,
EGBERT T. BUSH,
Auditing Committee.

Financial Statement

AGRICULTURAL COLLEGE STATION

EXPENDITURES BY ABSTRACTS CHARGEABLE AGAINST HATCH AND ADAMS FUNDS
FOR THE YEAR ENDED JUNE 30, 1924

Abstract	*Hatch*	*Adams*
Salaries	$11,130.82	$12,840.01
Labor	670.28	169.18
Stationery	141.19	28.11
Scientific Supplies	236.21	1,167.80
Feeding Stuffs	360.00	....
Sundry Supplies	225.43	54.70
Fertilizers	52.50	....
Communication Service	77.47	....
Travel Expenses	1,268.61	....
Transportation of Things	8.20	9.48
Publications	187.36	....
Heat, Light, Water, Power	208.19	296.26
Furniture, Fixtures	27.60	20.15
Library	....	....
Scientific Equipment	51.00	200.50
Livestock	....	....
Tools, Machinery, Appliances	349.38	30.60
Buildings and Land	1.70	183.21
Contingent Expenses	4.00	....
	$15,000.00	$15,000.00

HENRY P. SCHNEEWEISS,
Treasurer.

Report of the Director

Jacob G. Lipman

The modern experiment station is not a simple organization. Its problems have been increasing in number and complexity, until today they cover in the average state a very wide range. The New Jersey Station covers an even wider range in its activities than the average experiment station. Aside from the numerous research problems under investigation in the departments of the institution, there are those having to do with regulatory questions as well as those of a purely educational character. In most states the agricultural extension service is located in the college of agriculture; in New Jersey it is partly in the college and partly in the experiment station. Furthermore, the farmers of New Jersey have been for many years in more intimate contact with their station than is generally the case in other states. This more intimate contact makes for a larger volume of correspondence and more numerous requests for personal service of different sorts.

In the nature of things, the offices and laboratories of the department of the experiment station are located at New Brunswick. At the same time much field work is, of necessity, carried on in other localities—particularly in central and southern New Jersey. Some of the experiments thus carried on outside of New Brunswick are of a temporary, others of a more permanent, character. The exact nature of these inquiries and investigations is brought out more clearly in the following pages. At this time it may not be out of place to point out that the study of certain problems is organized in a definite way at points in the state where the best facilities for the investigations in question exist. Thus, laboratory and plot experiments are in progress at Whitesbog, N. J. This virtually represents the activities of a cranberry substation where soil, insect, botanical, water supply and other questions are being investigated. Important data have been accumulated at Whitesbog through a series of years, and their significance is already seen in the adjustments made by progressive cranberry growers in producing the crop. Incidentally, the study of cultivated blueberries is also being followed at Whitesbog. Investigations on the biological purification of sewage are being carried on at the sewage disposal plant owned by the city of Plainfield. Also, in this case, the experiments must be conducted through a series of years. In like manner, a permanent oyster research laboratory is located at Bivalve, N. J.; egg-laying contests at Vineland and Westwood, re-

spectively, and investigations on the growing of potatoes, sweet potatoes and fruit in Salem and Cumberland Counties. Outside experiments of a more transitory character are scattered widely. Some of these have to do with the study of mosquito-control problems; others with the production of small fruits; still others with the growing of vegetables under north Jersey conditions; others still with the growing of asparagus, etc. These experiments are entirely apart from the so-called demonstration experiments, running into the hundreds and supervised by members of the extension staff.

Research and demonstration activities carried on outside of New Brunswick create administrative problems. Traveling expenses represent one of the large items in the budget of the experiment station. It is not always a simple matter to determine whether it would be most economical to increase the number of institution-owned cars or to allow members of the staff to use privately-owned cars in connection with official business. From the administrative point of view it is desirable that experiments and demonstrations be located at points where their maintenance would be least costly. Due consideration should be given, of course, to the reaching of the largest number of people who might benefit from such experiments and demonstrations. Consideration must be given, likewise, to such questions as soil type, commercial practices, cost of travel to and from the experiments, ease of contact with the central plant at New Brunswick, etc. The situation is complicated by the insistence of certain groups of growers that experiments be located within their reach, even though a different location might be preferable from the point of view of all of the growers.

Another problem which is of considerable moment from the administrative point of view is the proper coordination of research and extension teaching. The investigator dealing with fundamental problems seldom has the time, and often lacks the ability, to present his findings clearly to persons who might derive economic benefits from the information gathered by the investigator. It is generally assumed that the extension specialist and the county agent should be ready to utilize directly such of the investigator's data as might contribute to the progress of our agricultural industry. Of late years it has become increasingly evident that in certain types of investigation there is a wide gap between the research man and the extension teacher. In such cases it is desirable to add to the staff men possessing both technical knowledge and ability to interpret to extension workers and to farmers such scientific data as may need interpretation. Such men should have the time and the inclination to read widely and to inform themselves concerning the inter-relationship of important economic factors in our agriculture. There is need for such men at most of our agricultural colleges and experiment stations.

The regulatory activities of the station may have no direct connection with research and extension service. Nevertheless, whether it be the analysis of fertilizers and feeding stuffs, the inspection of

creameries and milk stations, or the examination of samples of seed, the county agents, extension specialists and members of the research staff must be in more or less frequent communication with the control departments in order that they may best be able to provide timely advice and information to the farmers and gardeners in the state. For this reason, the location of certain types of the regulatory service in the station is of distinct advantage, even though such activities are not the primary and imporant functions of the experiment station.

NEW TYPES OF SERVICE

From time to time new problems are brought to the attention of the experiment station, and the request is made that consideration be given to the solution of these problems. Such requests may have to do with extension teaching, research or the regulatory service. For instance, there is at present an insistent demand for the inauguration of a system of inspection that would exclude from our hatcheries eggs infected with organisms which cause white diarrhea in chicks. The department of agriculture and the experiment station have arranged, as a result of this request, to provide this type of service to the poultrymen in the state. The suburban areas of New Jersey are paying more attention than ever to the development of landscaping, the planting of shade trees and ornamental trees and shrubs, and to the growing of greater quantities and of a greater variety of annual and perennial flowering plants. The horticulturist of the station finds that his correspondence concerning floricultural matters is expanding, and that the requests for addresses before garden clubs and other groups of persons in the smaller towns and suburban areas are increasing in number. Other requests for service not hitherto rendered by the station, or for the extension of activities already carried on, are brought to the attention of the institution. There is at present acute interest among our farmers in marketing problems, and, in general, in economic questions which affect agricultural prosperity. It becomes necessary, therefore, from time to time, to adjust the organization in the departments of the station in such manner as to provide for the consideration of the new questions that arise.

RESEARCH PROJECTS

A list of the research projects of the station is given in the following pages. A discussion of these projects will be found in the department reports. It need only be noted at this time that some of the projects deal with needs and problems that are local and temporary, while others are sufficiently wide in their scope to affect questions which arise in other states in this country as well as in foreign countries. Some of the research projects concern the development of the agricultural resources of New Jersey. Now and then they antici-

pate by many years changes in the character of our farming. This is an important feature of station research, for in most regions, and especially in th eastern states, there is a rapid shifting of centers of rural and urban production. Land areas which in the preceding decade may have played an important role as a source of the supply of certain foods may now be passing out of circulation as agricultural territory. In New Jersey, particularly, the development of the metropolitan district is being felt strongly. The completion of the vehicular tunnel under the Hudson and of bridges over the Delaware will intensify the migration of large numbers of people into southern and northern New Jersey. Many thousands of acres now in farms will within a few years cease to be used for that purpose. It is true, particularly of Bergen, Passaic and Essex Counties, that the inrush of people from the cities is raising land values to a point where farming becomes unprofitable. It is safe to forecast that Monmouth, Middlesex, Somerset and Mercer Counties will have to assume in the near future the task of growing crops which at present are being grown very effectively in the counties of northern New Jersey. This may well serve to illustrate the responsibility of the station in planning its studies and experiments so as to provide information on the future as well as the present agricultural needs of the state. A more detailed consideration of the specific activities of the departments of the station is given in the department reports which follow.

THE COLLEGE FARM

Because of the fact that the fiscal year closes in the height of the farming season, it seems logical to base the annual report of this department on the crop year of 1923. In that year the farm contained 390 acres directly under the control of this department. Of these, 130 acres were in wood land, 56 acres in pasture (not cropped), and 204 acres in cropped land. The rotation practiced on the cropped area was identical with that of previous years, namely, corn, oats and peas, and alfalfa. Mixed hay was substituted for alfalfa where the land was not suitable for the latter.

CROP	Total Area	Total Yield	Average Yield Per Acre	Cost Per Ton
	acres	*tons*	*tons*	
Corn	41.52	378.35	9.12	$10.08
Alfalfa	37.00	82.80	2.24	14.11
Mixed Hay	24.00	28.79	1.20	11.34
Oats and Pea Hay	15.00	17.72	1.18	32.33
Pasture	87.00	39.78	0.46	14.70

The year 1923 was very unfavorable for the production of the crops mentioned above. There was a long, dry spell in the summer and a wet spell in the spring, so that the yields were lower on the average than those of the previous year. These are itemized, and the total acreage, total yield, average yield and cost per ton are shown for the various crops.

PUBLICATIONS

The department of publications has continued its activities during the past year along the lines described in previous reports.

During the year the publications of the department consisted of 10 bulletins, 15 circulars, 7 extension bulletins, 12 Hints to Poultrymen, 12 issues of New Jersey Agriculture, and 49 papers of the journal series as listed below. Several former publications, the supply having become exhausted, were reprinted. Also 166 regular news articles were issued through the extension news service.

Bulletins

No.

388 Observations on the Relations Between Atmospheric Conditions and the Behavior of Mosquitoes. Willem Rudolfs.

389 The Prediction of Egg Records. G. W. Hervey.

390 Annual Report of the Sewage Substation, June 30, 1923. Willem Rudolfs.

391 The Peach Tree Borer in New Jersey (with notes on similar pests). Alvah Peterson.

392 Analyses of Materials Sold as Insecticides and Fungicides During 1923. Charles S. Cathcart, Ralph L. Willis and L. R. Smith.

393 Analyses of Commercial Fertilizers, Fertilizer Supplies and Home Mixtures, 1923. Charles S. Cathcart.

394 A Bacteriological Study of a Sewage Disposal Plant. W. H. Gaub, Jr.

395 Analyses of Commercial Fertilizers and Ground Bone; Analyses of Agricultural Lime, 1923. Charles S. Cathcart.

396 Fertilizer Registrations for 1924. Charles S. Cathcart.

397 Results of Seed and Legume Inoculant Inspection, 1923. Jessie G. Fiske.

307 The Domestic Flies of New Jersey. Charles H. Richardson. (Reprint.)

347 The Artificial Incubation and Brooding of Turkeys. H. W. Graybill. (Reprint.)

363 Diseases of Poultry. Willard C. Thompson and Linden S. Dodson. (Reprint.)

Circulars

155 Lettuce Culture in New Jersey. Howard F. Huber.

156 P-C-Benzene for Controlling the Peach Tree Borer. Alvah Peterson.

157 Creamery Inspection in New Jersey. F. C. Button.

158 Propagation and Top Working of Orchard Fruits. R. P. Armstrong and F. J. Rimoldi.

159 The Use of Explosives in Agriculture. Edward R. Gross.

160 A Farm Account Manual for New Jersey Farmers. Henry Keller, Jr.

161 Weeds of New Jersey. Jessie G. Fiske.

162 Spray Calendar for Apples and Quinces.

163 Spray Calendar for Peaches.

164 Spray Calendar for Pears.

165 Spray Calendar for Plums and Cherries.

166 Spray Calendar for Grapes.

No.
167 Tentative Plan for Combating the Oriental Peach Moth. Thomas J. Headlee.
168 Spray to Prevent the Attack of Japanese Beetle.
169 The Care and Management of Baby Chicks. Willard C. Thompson and Norman R. Mehrhof.
90 Feeding and Management of Swine. William C. Skelley. (Reprint.)
99 Asparagus Growing in New Jersey. Roscoe W. DeBaun. (Reprint.)
130 Mosquito Manual. (Reprint.)
152 Plans and Specifications of Poultry Buildings. (Reprint.)

Extension Bulletins

32 How to Inoculate Legumes. Herbert R. Cox.
33 Alfalfa Lowers Feed Cost and Leaves Land Fertile. Herbert R. Cox.
34 Sweet Clover. Herbert R. Cox.
35 Register of Production Cows. E. J. Perry.
36 Some Important Factors in Poultry Raising. Allen G. Waller and Willard H. Allen.
37 Some Facts on Vegetable Yields. Allen G. Waller.
38 Winter Cover Crops for New Jersey. Herbert R. Cox.

New Jersey Agriculture

Vol. 5, No. 7-12.
Vol. 6, No. 1-6.

Hints to Poultrymen

Vol. 11, No. 10—Egg Prices and Cold Storage Holdings. George W. Hervey.
Vol. 11, No. 11—New Jersey's Poultry Exhibitions. Willard C. Thompson.
Vol. 11, No. 12—Organizing a Poultry Plant. George G. Sawyer.
Vol. 12, No. 1—Some Lessons from Production Records. George W. Hervey.
Vol. 12, No. 2—Vitamines and Their Relation to Poultry Diseases. F. R. Beaudette.
Vol. 12, No. 3—Report of Egg Laying Contests for 1923. Ralston R. Hannas and Forest H. Clickner.
Vol. 12, No. 4—Egg Production, Monthly Costs and Receipts on New Jersey Poultry Farms. Willard H. Allen.
Vol. 12, No. 5—Getting Maximum Results from the Incubator. William P. Thorp.
Vol. 12, No. 6—Diseases of Baby Chicks. F. R. Beaudette.
Vol. 12, No. 7—Why Chicks Die. Willard H. Allen.
Vol. 12, No. 8—The New Jersey Multiple Brooder House. William P. Thorp.
Vol. 12, No. 9—A Description of the Method for Collecting Blood Samples from Breeding Stock to Be Tested for "Carriers" of Bacillary White Diarrhea. F. R. Beaudette.
Vol. 9, Nos. 1, 4, 8, 10. (Reprints.)
Vol. 10, Nos. 1, 2, 7, 8, 9, 11, 12. (Reprints.)
Vol. 11, Nos. 4 and 5. (Reprints.)
Vol. 6, No. 8. (Reprint.)
Vol. 8, No. 1. (Reprint.)

Report

1923—Forty-fourth Annual Report of the New Jersey State Agricultural Experiment Station and Thirty-sixth Annual Report of the New Jersey Agricultural College Experiment Station.

Extension News Service

Rural Ruminations, Nos. 79 to 113.
Home Cogitations, Nos. 54 to 62.
Timely Tips to Gardeners, Nos. 11 to 15 (1923).
Miscellaneous stories from the different departments published in the weekly, the daily and the agricultural press.

List of Available Publications

January, 1924

Journal Series

No.

140 E. S. Stinson and J. W. Shive. An Effective Absorption Apparatus. *Science.* February 22, 1924.

141 R. V. Allison. The Modulus of Rupture of a Soil as an Index to It's Physical Structure. *Journal of American Society of Agronomy.* October, 1923.

142 G. W. Hervey and H. R. Lewis. The Relation of External Body Characteristics to Annual Production in Barred Plymouth Rocks. *Poultry Science.* February-March, 1924.

143 C. H. Connors. Twin and Triplet Peaches. *Journal of Heredity.* May, 1923.

144 R. V. Allison. The Effect of Aeration Upon the Development of Barley in a Heavy Clay Soil. *Soil Science.* February, 1924.

145 Willem Rudolfs. Influence of Temperature and Initial Weight of Seeds Upon the Growth Rate of Phaseolus Vulgaris. *Journal of Agricultural Research.* December 15, 1923.

146 Willem Rudolfs. Influence of Salt Upon the Growth Rate of Asparagus. *Journal of Agricultural Research.*

147 Alvah Peterson. Some Chemicals Attractive to Adults of the Onion Maggot (Hylemyia Antiqua Meig.) and the Seed Corn Maggot (Hylemyia Cilicrura Rond). *Journal of Econmic Entomology.* February, 1924.

148 J. G. Lipman and A. W. Blair. The Utilization of Nitrogen in Soils and Fertilizers as Affected by Lime. *Journal of Industrial and Engineering Chemistry.* April, 1924.

149 J. G. Lipman. The Value of Sulfur in Soil Improvement and Crop Production. *Journal of Industrial and Engineering Chemistry.* March, 1924. French translation published in *Chimie et Industrie.* May, 1924.

150 S. W. Mead, W. M. Regan and J. W. Bartlett. A Study of the Factors Affecting the Normal Growth of Dairy Heifers. *Journal of Dairy Science.* September, 1924.

151 R. V. Allison. Availability Studies with High Potash Nitrates. *Journal of American Society of Agronomy.* January, 1924.

152 S. A. Waksman and R. L. Starkey. Microbiological Activities of Soil as an Index of Soil Fertility: VII. Carbon dioxide Evolution. *Soil Science.* February, 1924.

153 Ray Hutson. The Honey Bee as an Agent in the Pollination of Pears, Apples and Cranberries. *Journal of Economic Entomology.* April, 1925.

154 C. H. Connors. Color Control in Forcing Hydrangeas. *Proceedings of the American Society for Horticultural Science.*

155 T. J. Headlee. Certain Dusts as Agents for the Protection of Stored Seeds from Insect Infestation. *Journal of Economic Entomology.* April, 1924.

156 R. L. Starkey. Some Observations on the Decomposition of Organic Matter in Soils. *Soil Science.* April, 1924.

157 S. A. Waksman and H. Heukelekian. Microbiological Analysis of Soil as an Index of Soil Fertility: VIII. Cellulose Decomposition. *Soil Science.* April, 1924.

No.

158 M. A. Blake. Climatic, Soil and Cultural Factors Which Determine Whether or Not We Secure Fancy Peaches and Apples. *Proceedings of New Jersey Horticultural Society for 1923.*

159 Willem Rudolfs and F. L. Campbell. Changes Occurring in the Process of Sewage Digestion in Alternating Imhoff Tanks. *Public Works.*

160 F. L. Campbell and Willem Rudolfs. Variation in Gas Production in Imhoff Tanks. *The Canadian Engineer.* April 14, 1924.

161 A. T. Perkins. The Effect of Several Mineral Fertilizers Upon the Nodulation of Virginia Soybeans. *Soil Science.* June, 1924.

162 A. T. Perkins. Considerations on the Nodulation of Soybeans. *Soil Science.* June, 1924.

163 S. A. Waksman and R. L. Starkey. Influence of Organic Matter Upon the Development of Fungi, Actinomycetes and Bacteria in Soil. *Soil Science.* May, 1924.

164 A. W. Blair and A. L. Prince. Preliminary Note on the Distribution of Nitrates in Soil Under Corn Culture. *Soil Science.* April, 1924.

165 Willem Rudolfs. Influence of External Conditions Upon the Behavior of Mosquitoes. *Proceedings of New Jersey Mosquito Association.*

166 S. A. Waksman and P. D. Karunakar. Microbiological Analysis of Soil as an Index of Soil Fertility: IX. Nitrogen Fixation and Mannite Decomposition. *Soil Science.* May, 1924.

167 S. A. Waksman and S. Lomanitz. Contribution to the Chemistry of Decomposition of Proteins and Amino Acids by Various Groups of Microörganisms. *Journal of Agricultural Research.* February, 1925.

168 S. A. Waksman. Influence of Microörganisms Upon the Carbon-Nitrogen Ratio in the Soil. *Journal of Agricultural Science.* October, 1924.

169 A. W. Blair and A. L. Prince. The Influence of Varying Ratios of Phosphoric Acid and Potash on Crop Yield and Nitrogen Recovery. *Soil Science.* April, 1924.

170 F. L. Campbell and W. Rudolfs. Studies on the Chemical Changes Occurring in a Sprinkling Filter. *Public Health News.*

171 G. W. Hervey. A Note on the Inheritance of Egg Production in the Leghorn Fowl. *Poultry Science.* April-May, 1924.

172 M. Hotchkiss. Studies on the Biology of Sewage Disposal. A Survey of the Bacteriological Flora of a Sewage Treatment Plant. *Journal of Bacteriology.* September, 1924.

173 A. T. Perkins. The Effect of Bacterial Numbers on the Nodulation of Virginia Soybeans. *Journal of Agricultural Research.* January, 1925.

174 A. T. Perkins. Regarding the Possible Adaptation of Soybean Radicicola for a Specific Host Variety. *Journal of Agricultural Research.* February, 1925.

175 J. S. Joffe and H. C. McLean. Alkali Soil Treatment: 1. A Consideration of Some Colloidal Phenomena. *Soil Science.* May, 1924.

176 Albert F. McGuinn. The Action of Dicyandiamid and Guanyl Urea Sulfate on Plant Growth. *Soil Science.* June, 1924.

177 Willem Rudolfs. Effect of Seeds Upon Hydrogen-ion Concentration Equilibrium in Solution. *Journal of Agricultural Research.*

178 N. Mogendorff. A Preliminary Note on Arsenic Injury of Fruit Tree Foliage. *Journal of Agricultural Research.*

179 M. Hotchkiss. Studies on the Biology of Sewage Disposal. A Sprinkling Filter Bed and Its Bacterial Population. *Journal of Bacteriology.* September, 1924.

180 Willem Rudolfs. Some Sewage Experimental Work Accomplished and Under Investigation at the Sewage Substation During 1923. *Proceedings of the New Jersey Sewage Works Association.*

181 Geo. W. Musgrave. Depression of Check Row Yields by Adjoining High Yielding Plot Rows in Potatoes. *Journal of American Society of Agronomy.* October, 1924.

182 R. P. Marsh and J. W. Shive. The Adjustment of the Iron Supply to the Requirements of the Soybean in Solution Culture. *Botanical Gazette.* March, 1925.

No.

183 G. W. Fant. The Manner of Infection of Peach Twigs by Brown Rot Fungus. *Phytopathology.* September, 1924.

184 A. W. Blair and A. L. Prince. Some Changes Brought About in Cylinder Soils by Long Continued Crop and Fertilizer Treatment. *Soil Science.* July, 1924.

185 Willem Rudolfs. Organization and Program of the Sewage Substation and Some Results Obtained. *Journal of the American Water Works Association.* January, 1925.

186 S. Lomanitz. The Influence of Sodium Chloride Upon Alfalfa Grown in Solution Cultures. *Soil Science.* November, 1924.

187 J. S. Joffe and H. C. McLean. Alkali Soil Investigations: II. Origin of Alkali Soils, Physical Effects of Treatments. *Soil Science.* July, 1924.

188 Willem Rudolfs. Mosquito Breeding in Specific Places. *Journal of Parasitology.* December, 1924.

189 R. L. Starkey. Concerning the Physiology of T. thioxidans, an Autotrophic Bacterium Oxidizing Sulfur Under Acid Conditions. *Journal of Bacteriology.* March, 1925.

190 R. L. Starkey. Concerning the Carbon and Nitrogen Nutrition of T. thioxidans, and Autothropic Bacterium Oxidizing Sulfur Under Acid Conditions. *Journal of Bacteriology.* March, 1925.

Other Technical Papers

HANNAS, R. R.

An Analysis and Interpretation of Heavy Grain Feeding. *Poultry Science.* August-September, 1924.

LIPMAN, J. G.

Report of the Advisory Committee of the American Society of Agronomy. *Journal of American Society of Agronomy,* vol. 16, no. 2, p. 81-86.

MARTIN, W. H.

Report of Plant Pathologist. *N. J. Dept. Agr. Bul.* 38, p. 113-116, 1924.

Results of Experimental Work in 1923. *N. J. Dept. Agr. Bul.* 39, p. 156-163. 1924.

Results of Fruit and Vegetable Disease Control Investigations. *Proceedings Annual Meeting, N. J. State Horticultural Society,* 1924, p. 84-90.

Stabilizing the Potato Industry. *Proceedings 10th Annual Meeting, Potato Association of America,* 1923, p. 80-85.

The Relation of Soil Environment to the Development of Plant Diseases. *Southern Florist and Nurseryman,* September 7, 1923, p. 6-7.

POOLE, R. F.

Development in the Control of Sweet Potato Diseases. *Annual Report New Jersey State Horticultural Society,* 1923.

WOODWARD, C. R.

The Curriculum of the College of Agriculture. *Educational Review,* January, 1924.

Popular Papers

BLAIR, A. W.

Plant-Food—Not How Much, but How Readily Available. *American Agriculturist.* February 2, 1924.

Lime, Legumes and an Invisible Army. *Pennsylvania Farmer.* April 5, 1924.

HANNAS, RALSTON R.

Daylight at Night. *American Poultry Advocate.* November, 1923.
Winter Egg Production. *American Poultry Advocate.* December, 1923.
Artificial Incubation. *American Poultry Advocate.* February, 1924.
Egg-Laying Contests in New Jersey. *American Poultry Journal.* July, 1924.
The Value of Heavy Grain Feeding. *American Poultry Journal.* November, 1924.
When He Switched to Hens. *Country Gentleman.* January 19, 1924.
Money-Making Eggs. *Country Gentleman.* February 9, 1924.
Here's the Postman With the Chicks. *Country Gentleman.* February 16, 1924.
Spring Tonic for Hens. *Country Gentleman.* March 8, 1924.
Safe Cure for Gapes. *Country Gentleman.* June 21, 1924.
Capons as a Side Line. *Country Gentleman.* August 9, 1924.
Feed Mixtures. *Pennsylvania Farmer.* February 2, 1924.
The Most Common Poultry Diseases. *Pennsylvania Farmer.* February 9, 1924.
Lice Control. *Pennsylvania Farmer.* February 23, 1924.
What's Behind Those Baby Chicks. *Pennsylvania Farmer.* March 8, 1924.
Equipment in Repair. *Pennsylvania Farmer.* July 5, 1924.

LIPMAN, J. G.

The Story of the Soil. *American Agriculturist.* January 19, 1924.
The Value of Peat in Soil Improvement. *Farm and Home.* December, 1923.
Sussex County and Its Agricultural Interests. *Merchants National Bank Quarterly,* Newton, N. J.
Some New Things in Our Agricultural Activities. *New Jersey State Department of Agriculture Bul.* 38.
Sources of Ammonia in Potato Fertilizers. *New Jersey State Department of Agriculture Bul.* 39.
Anti-Mosquito Legislation. *Proceedings 11th Annual Meeting, New Jersey Mosquito Extermination Association,* 1924.
The National Wheat Conference. *Pennsylvania Farmer.* July 29, 1923.

MARTIN, W. H.

Certification Rules for 1923. *Hints to Potato Growers,* v. 4, no. 3. July, 1923.
Potato Scab and the Weather. *Hints to Potato Growers,* v. 4, no. 4. August, 1923.
Prepare for Late Blight Now. *Cumberland County Board of Agriculture News Letter.* September, 1923.
Fertilizer and Scab. *Hints to Potato Growers,* v. 4, no. 6. October, 1923.
Seed Potato Studies in 1923. *Hints to Potato Growers,* v. 4, no. 7. November, 1923.
Seed and Soil Treatment for the Control of Potato Scab. *Hints to Potato Growers,* v. 4, no. 8. December, 1923.
Ten Years of Potato Spraying. *Hints to Potato Growers,* v. 4, no. 9. January, 1924.
The Potato Tuber Moth. *Hints to Potato Growers,* v. 4, no. 10. February, 1924.
The 1924 Potato Crop. *Hints to Potato Growers,* v. 4, no. 11. March, 1924.

MUSGRAVE, G. W.

Size of Potato Seed Piece—Some Pros and Cons. *Hints to Potato Growers.* April, 1924.

POOLE, R. F.

Something About Stem Rot of Sweet Potatoes. *Gloucester County Farm Bureau News.* August, 1923.
Why Select Sweet Potato Seed. *Gloucester County Farm Bureau News.* September, 1923.
Tomato Crop Losses May be Reduced. Streak and Filiform Disease Checked by Destroying Weeds and Insects. *Seed World,* v. 15, no. 5. March 7, 1924.

LIST OF PROJECTS OF THE NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS FOR THE YEAR 1923-24

DEPARTMENT OF AGRICULTURAL ECONOMICS

Department and Project No.	Subject	Leader	* Associates
AE 1	Cost of production of farm products	A. G. Waller	
AE 2	Cost of potato production	A. G. Waller	
AE 3	Cost of farm power	A. G. Waller	
AE 4	Methods of maintaining soil fertility	A. G. Waller	
AE 5	Economic study of the poultry industry	Henry Keller, Jr.	
AE 6	Economic study of the peach industry	A. G. Waller	
AE 7	Economic study of the apple industry	A. G. Waller	
AE 8	The rye marketing system of central Jersey	A. G. Waller	

DIVISION OF AGRONOMY AND SOILS

Department and Project No.	Subject	Leader	* Associates
A 1	Potatoes on alfalfa sod	G. W. Musgrave	
A 2	Alfalfa strains	G. W. Musgrave	
A 3	Size of potato seed piece	G. W. Musgrave	
A 4	Corn breeding by inbreeding and selection in self-fertilized lines	G. W. Musgrave	H. B. Sprague
A 5	Time of planting late crop potato seed	G. W. Musgrave	
A 6	Potato variety test	G. W. Musgrave	
A 7	Potato storage	G. W. Musgrave	
A 8	Tests of species and varieties of field crops	G. W. Musgrave	
A 9	Improvements of potato seed	G. W. Musgrave	
A 10	Amount and rate of growth in certain field crops	G. W. Musgrave	

LIST OF PROJECTS OF THE NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS FOR THE YEAR 1923-24 —Continued

SOIL CHEMISTRY AND BACTERIOLOGY

Department and Project No.	Subject	Leader	Associates
S. C. & B. 3	Sulfur oxidation	J. G. Lipman	A. W. Blair A. L. Prince J. S. Joffe S. A. Waksman
S. C. & B. 5	Fertilizer ratio experiments	A. W. Blair	W. H. Martin
S. C. & B. 7	Fertilizer ratio experiments	A. W. Blair	W. H. Martin
S. C. & B. 9	Toxicity of Borax	A. W. Blair	
S. C. & B. 10	Sodium Chloride	A. W. Blair	R. M. Barnette
S. C. & B. 11	Weed plots, or the influence of fertilizers upon natural vegetation	J. G. Lipman	A. W. Blair A. L. Prince
S. C. & B. 12	Utilization of plant-food nitrogen in the presence of phosphoric acid and potash	A. W. Blair J. G. Lipman	H. C. McLean A. L. Prince
S. C. & B. 13	The influence of soil reaction on the fixation of nitrogen by legumes,	J. G. Lipman	A. W. Blair A. L. Prince
S. C. & B. 14	Soil actinomycetes	S. A. Waksman	Clara Wark J. S. Joffe
S. C. & B. 15	Ammo Phos as a fertilizing material	J. G. Lipman A. W. Blair	
S. C. & B. 16	Chemical and bacteriological studies on peat	J. G. Lipman	S. A. Waksman
S. C. & B. 17	Physical, chemical and biochemical studies of soil to which nitrate of soda has been applied	J. G. Lipman	A. W. Blair
S. C. & B. 18	Lime to improve the crop-producing power of acid soils	A. W. Blair	
S. C. & B. 19	The relation of sulfur, sulfur phosphate mixtures, fertilizers, manure, lime and varieties to yield and disease control of sweet potatoes	R. F. Poole H. C. McLean	

LIST OF PROJECTS OF THE NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS FOR THE YEAR 1923-24 —Continued

BOTANY AND PLANT PATHOLOGY—

Department and Project No.	Subject	Leader	Associates
P. Path. 3	Horse-radish root rot	R. F. Poole	
P. Path. 4	Celery root-rot	R. F. Poole	
P. Path. 5	Egg-plant wilt	C. M. Haenseler	
P. Path. 7	Spraying to control pear fruit and leaf spot	W. H. Martin	
P. Path. 10	The use of elemental sulfur for the control of potato scab	W. H. Martin	
P. Path. 11	Physiological studies of potato scab	W. H. Martin	
P. Path. 12	Control of foliage diseases of the potato by the use of Bordeaux mixture	W. H. Martin	
P. Path. 13	Tuber-borne diseases of the potato	W. H. Martin	
P. Path. 14	Root-rot of field peas	C. M. Haenseler	
P. Path. 15	Root-rot disease of corn	W. H. Martin	
P. Path. 18	Physiological studies in seed potatoes	W. H. Martin	
P. Path. 19	Potato fertilizers	W. H. Martin	
P. Path. 20	Sweet potato diseases	R. F. Poole	
P. Path. 21	Controlling foliage diseases of the tomato with dust and sprays	R. F. Poole	
P. Path. 22	Peach wilt	C. M. Haenseler	
P. Path. 23	Studies on fruit diseases	W. H. Martin	

PLANT PHYSIOLOGY

P. Ph. 1	Salt requirements of representative agricultural plants	J. W. Shive	W. H. Martin
P. Ph. 5	The relative availability and efficiency of various soluble and insoluble iron compounds in relation to plant production	J. W. Shive	
P. Ph. 6	Study of ammonium sulfate in relation to plant growth	J. W. Shive	
P. Ph. 7	A study of plant growth and crop production in relation to the size and weight of seed	J. W. Shive	

[illegible] AGRICULTURAL EXPERIMENT STATIONS FOR THE YEAR 1923-24
—Continued

DAIRY HUSBANDRY

Department and Project No.	Subject	Leader	Associates
D. H. 1	Breeding experiments with dairy cattle	J. W. Bartlett	C. B. Bender
D. H. 2	Feeding milch cows during the dry period	J. W. Bartlett	C. B. Bender
D. H. 4	Minimum milk requirements for raising dairy calves	J. W. Bartlett	C. B. Bender
D. H. 5	Factors affecting the total butterfat content of cows' milk during a period of two days	J. W. Bartlett	C. B. Bender
D. H. 7	Rations for dairy heifers during the winter months	J. W. Bartlett	C. B. Bender
D. H. 9	The relation of the ductless glands to growth and milk production	J. W. Bartlett	C. B. Bender
D. H. 10	Studies of color pigmentation in the skin of dairy cattle	J. W. Bartlett	C. B. Bender
D. H. 11	A study of the changes that take place in the topline of dairy calves,	J. W. Bartlett	C. B. Bender
D. H. 12	A study of the effect of the plane of nutrition of milch cows during the dry period upon the subsequent lactation	J. W. Bartlett	C. B. Bender
D. H. 13	The effectiveness of commercial preservatives in composite samples, with special reference to bichloride of mercury	J. W. Bartlett	F. C. Button
D. H. 14	The relation of alfalfa meal as a roughage to mastitus in milking cows	J. W. Bartlett	C. B. Bender

ENTOMOLOGY

E 1	Mosquito control	T. J. Headlee	
E 2	Climate and insect investigations	T. J. Headlee	
E 3	Orchard insect investigations	T. J. Headlee	
E 4	Small fruit insect investigations	T. J. Headlee	A. Peterson
E 5	Vegetable insect investigations	T. J. Headlee	
E 6	Insects injurious to market milk	T. J. Headlee	A. Peterson
E 7	Arthropods injurious to poultry production	T. J. Headlee	
E 8	Stickers, spreaders and dilutants for dusting and spraying mixtures,	T. J. Headlee	
E 9	Cranberry problems		A. Peterson

ENTOMOLOGY—Continued

Department and Project No.	Subject	Leader	Associates
E 10	The biology of sewage disposal	T. J. Headlee	W. Rudolfs
E 11	Greenhouse insect investigations	T. J. Headlee	
E 12	Soil infesting insects	T. J. Headlee	

OYSTER RESEARCH

Department and Project No.	Subject	Leader	Associates
Oy 1	Scientific methods of oyster culture	T. C. Nelson	

HORTICULTURE

Department and Project No.	Subject	Leader	Associates
H 1	Plant-food studies with peaches	M. A. Blake	A. J. Farley C. H. Connors
H 2	Peach pruning	M. A. Blake	C. H. Connors
H 3	Apple pruning	M. A. Blake	A. J. Farley
H 4	Peach breeding	C. H. Connors	M. A. Blake A. J. Farley
H 5	Plant-food studies with apples	A. J. Farley	
H 6	Two methods of planting peach trees	A. J. Farley	
H 7	Rate of growth of fruits, apple, peach, pear	A. J. Farley	J. H. Clark
H 9	Carnation breeding	C. H. Connors	
H 10	Carnation culture	M. A. Blake	C. H. Connors
H 11	Rose culture	M. A. Blake	C. H. Connors
H 12	Plant-food studies with tomatoes	L. G. Schermerhorn	
H 14	Environmental factors in hydrangea culture	C. H. Connors	M. A. Blake
H 15	Plant-food studies with sweet potatoes	L. G. Schermerhorn	
H 16	Plant-food studies with asparagus	L. G. Schermerhorn	

LIST OF PROJECTS OF THE NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS FOR THE YEAR 1923-24 —Continued

HORTICULTURE—Continued

Department and Project No.	Subject	Leader	Associates
H 17	Cantaloupe studies	L. G. Schermerhorn	
H 18	Root stocks for peaches and apples	M. A. Blake	
H 19	Cultural studies with herbacious perennial plants	C. H. Connors	
H 20	Studies with miscellaneous vegetables in north Jersey	L. G. Schermerhorn	H. F. Huber
H 21	Factors influencing the size of peaches, including thinning studies	M. A. Blake	
H 22	Influence of amounts and time of application of nitrogen on yields of various vegetables	L. G. Schermerhorn	
H 23	Influence of size of root on growth and yield of asparagus	L. G. Schermerhorn	H. F. Huber

POULTRY HUSBANDRY

P. H. 3	Improvement of poultry through the establishment and operation of egg-laying and breeding contests	W. C. Thompson	R. R. Hannas
P. H. 4	The improvement of poultry through the aiding of poultry exhibition in New Jersey	F. R. Beaudette	
P. H. 10	Study of contagious epitheliesis	F. R. Beaudette	
P. H. 11	The diagnosis of poultry diseases occurring in New Jersey	F. R. Beaudette	
P. H. 13	The development of a high producing strain of single comb white Leghorns	W. C. Thompson	W. P [illegible] G [illegible]
P. H. 14	The analysis of individual egg-production records	W. C. Thompson	
P. H. 15	The relative influence of the sire and dam in breeding and mating for high production	W. [illegible]lee [illegible] Headlee	
P. H. 16	Inheritance in pigeons	[illegible] J. Headlee	

LIST OF PROJECTS OF THE NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS FOR THE YEAR 1923-24
—Continued

POULTRY HUSBANDRY—Continued

Department and Project No.	Subject	Leader	Associates
P. H. 18	The effects of using artificial lighting on breeding hens	W. C. Thompson	W. P. Thorp
P. H. 19	The correction factor in the analysis of differences in flock production	W. C. Thompson	W. P. Thorp
P. H. 20	The commercial production of roaster and capon poultry meat	W. C. Thompson	W. P. Thorp G. W. Hervey
P. H. 21	The economy and value of proven sires	W. C. Thompson	F. H. Clickner
P. H. 22	Breeding for factors essential to the exhibition of fowls	W. C. Thompson	M. Decker
P. H. 23	Natural poultry life span	W. C. Thompson	F. H. Clickner
P. H. 24	A study of Heterakis perspicillum on poultry	F. R. Beaudette	J. J. Black
P. H. 25	Observations on the occurrence of oocysts of Eumeria avium in the cecal contents of domestic fowls	F. R. Beaudette	
P. H. 26	Relation of soil reaction to infectious poultry disease organisms	F. R. Beaudette	
P. H. 26	The modification of existing poultry houses to provide optimum environment during winter confinement	W. C. Thompson	F. H. Clickner

SEED ANALYSIS

Department and Project No.	Subject	Leader	Associates
S. A. 1	Germination of beet seed	J. G. Fiske	
S. A. 2	Germination of celery seed	J. G. Fiske	
S. A. 3	Difference between mammoth red clover and common red clover	J. G. Fiske	
S. A. 4	Experiments in soil inoculation	J. G. Fiske	
S. A. 5	Longevity of grass and clover seeds	J. G. Fiske	
S. A. 6	The drying of agricultural seeds for the reduction of moisture content as a preservative measure in storage	J. G. Fiske	
S. A. 7	The best laboratory medium for germinating corn	J. G. Fiske	
S. A. 8	Disinfecting seeds	J. G. Fiske	

Report of the Department of Chemistry

CHARLES S. CATHCART

I. INTRODUCTORY

The laws of the State of New Jersey, which were enacted to regulate the sale of fertilizers, agricultural lime, insecticides and commercial feeding stuffs, prescribe certain work to be done. On account of its character, this work is entrusted to the department of chemistry. The inspection of the materials referred to in these laws requires practically the entire time of the members of the staff assigned to the department, and, consequently, the annual reports must be along the same general lines.

II. ADMINISTRATION

On account of the existing conditions, it is not possible to make the various inspections continuous during the entire year, and, in order to accomplish the greatest amount of work, it is necessary to prepare a schedule for the different inspections. During the fiscal year ending June 30, 1924, the work entrusted to the department was completed in accordance with the schedule. This was made possible by the faithfulness of each member of the staff.

All of the control laws require: (1) an annual registration of the brands to be offered for sale; (2) an annual inspection of the materials found on the markets, and (3) the publication of the results obtained. In addition to these requirements, the fertilizer and feeding-stuffs laws do not permit the lowering of the standard of a brand after it has been once registered. These two laws also require the manufacturers to render tonnage reports twice a year.

In order that all the records may be made in a uniform manner, the various printed forms are prepared and forwarded to the manufacturers. As the applications for registrations are received, a record is made for use during the year and the original applications are filed for future reference. A permanent record is also made of the fertilizer and feeding stuffs registered in order that future registrations may be readily checked before certificates are issued. The tonnage reports are also recorded and the reports filed. The detailed work required by the registrations requires a considerable amount of time during the year, but the records are valuable for immediate and future reference.

The following will show the number of registrations made during the year 1923 for which certificates were issued after proper records had been made:

Insecticide registrations	291
Fertilizer registrations	1,482
Lime registrations	90
Feeding stuffs registrations	2,190
Total number of registrations	4,053

During the year a total of 2,277 samples were examined and duly reported as soon as the work had been completed. The reports on the official samples were submitted to the purchaser of the materials and to the manufacturer, but the unofficial samples were reported only to the parties forwarding the samples.

The results secured during the various inpections were published in bulletins 392, 393, 395, 396 and 399.

III. INSPECTION OF INSECTICIDES AND FUNGICIDES DURING 1923

The detailed results of this inspection were published in bulletin 392 under date of October, 1923.

Registrations

In accordance with the requirements of the law (Chapter 89, Session of 1912), 50 manufacturers and dealers registered 291 brands which they intended to offer for sale.

Inspection

The official inspection and sampling of the materials were made by F. S. Beckwith, B.Sc., who has been engaged in this work for several years. Since there was no change made in the method of conducting the inspection, it was done with a knowledge of the many difficulties to be overcome in order to secure accurate and reliable samples of the various products.

The inspector followed an itinerary which had been prepared, and secured a total of 117 samples. The samples secured represented the larger shipment, and also the materials in the smaller original packages. In addition to the official samples, 10 samples were forwarded by individuals. These unofficial samples were examined and duly reported.

A summary of the inspection shows that the usual materials are being used and that a new mixture, which contains free sulfur as its active ingredient, is being used. The samples examined consisted of the following:

14 samples of Paris green
11 samples of lead arsenate powder
2 samples of lead arsenate paste
9 samples of calcium arsenate
14 samples of bordeaux mixture
3 samples of lime-sulfur solution
6 samples of soluble-sulfur compounds
6 samples of sulfur mixtures
11 samples of nicotine preparations
39 samples of miscellaneous brands
10 unofficial samples

125 total

Paris Green

Paris green is a compound of arsenic, copper, and acetic anhydrid. Paris green breaks down to a certain extent when water is added and, consequently, the soluble arsenic as found, may be derived either from the soluble arsenic originally present in the sample or from that portion made soluble by the addition of water.

The standard for Paris green as prescribed in the law is that it should not contain less than 50 per cent of arsenious oxide and that it should not contain arsenic in water-soluble forms equivalent to more than 3.50 per cent of arsenious oxide.

Fourteen samples were examined, all of which satisfied the requirements.

Lead Arsenate

Thirteen samples of lead arsenate were examined, 11 of which were in the powder form and the remaining 2 samples in the paste form.

The two most important determinations to be made on lead arsenate samples are the total arsenic oxide and the water-soluble arsenic. There is no legal standard for the dry, powdered lead arsenate, but it usually varies from 31 to 33 per cent of total arsenic oxide and, in carefully prepared materials, the water-soluble arsenic is usually less than 0.5 per cent. The standard for the paste form is that it should not contain (1) more than 50 per cent of water; (2) less than 12.5 per cent of arsenic oxide, and (3) water-soluble arsenic equivalent to more than 0.75 per cent of arsenic oxide.

All of the samples, with one exception, which contained an excess of water-soluble arsenic, satisfied the guarantees given.

Calcium Arsenate

Nine samples of calcium arsenate were examined, all of which satisfied the guarantees for total arsenic. Five samples did not contain the maximum guarantee for water-soluble arsenic. Four samples contained an excess of water-soluble arsenic.

Bordeaux Mixture

Fourteen samples of bordeaux mixture were examined and, while the composition was variable, the guarantees for the copper content were satisfied in every sample with one exception.

Lime-Sulfur Solution

Three samples of lime-sulfur solution were received and the content of total sulfur varied from 24.67 to 25.98 per cent.

Soluble-Sulfur Compounds

Six samples of soluble-sulfur compounds were examined. The content of total sulfur varied from 43.38 to 63.30 per cent. The variability of this class of materials should cause the direction of careful attention to the guaranteed composition and the selling price at the time a purchase is made.

Atomic Sulfur

Two samples of atomic sulfur were examined. The content of sulfur in both of the samples exceeded the guarantee.

Sulfur Mixtures

Four samples of materials containing sulfur as the principal ingredient were examined. They satisfied the guarantees given. The content of sulfur in these samples varied from 62.73 to 78.11 per cent.

Nicotine Preparations

Eleven samples containing nicotine as the active ingredient were examined. All the samples satisfied the guarantees given. The products varied in composition from 0.38 to 41.38 per cent of nicotine. In some of these mixtures the nicotine is in a volatile form. It is, therefore, very advisable when making a purchase to insist upon receiving a mixture that is in a tight can and that has not been in stock a long time.

Miscellaneous Brands

There were 39 samples examined which were mixtures sold by various manufacturers. All of these shipments, with one exception, were accompanied by the required guarantees. There were 4 deficient samples.

IV. INSPECTION OF COMMERCIAL FERTILIZERS DURING 1923

The detailed results of the fertilizer inspection were published in bulletins 382, 393 and 395.

Registrations

During the fiscal year ending October 31, 1923, 127 manufacturers and brokers registered 1,482 brands of mixed fertilizers and fertilizer materials.

The law requires the publication of the various registrations made, but the real value of this requirement does not seem equal to the expense attached, since the fertilizers covered by the registrations have been very largely sold before it is possible to have the information printed and distributed. This condition is caused, partially, at least, by the manufacturers who do not submit their registrations at the prescribed time. Under date of January 19, 1923, bulletin 382 was published, which contained all of the registrations that had been received up to date. The registrations that were received after January 19 were published in bulletin 395.

Reports of Tonnage

The manufacturers or parties responsible for the sale of fertilizers in this state are required to render on April 1 and November 1 of each year a certified report of the tonnage sold during the preceding months. Table 1 shows a summary of the tonnage sold during the last ten years.

TABLE 1

Summary of Tonnage Reports

Year	April Reports		November Reports		
	Mixed Fertilizers	Fertilizer Materials	Mixed Fertilizers	Fertilizer Materials	Total for the year
	tons	*tons*	*tons*	*tons*	*tons*
1914	78,768.27	8,735.62	59,223.26	8,686.28	155.414.14
1915	87,052.13	7,276.45	53,288.11	5,459.28	153,075.97
1916	61,368.88	9,032.68	52,328.81	7,069.70	129,800.07
1917	86,840.44	9,146.80	74,231.13	6,264.73	176.483.10
1918	90,371.85	6,544.66	51,404.20	4,877.90	153,198.61
1919	94,463.07	6,264.86	53,594.97	5,162.15	149,485.05
1920	87,942.01	6,452.28	64,847.51	5,579.13	164,820.93
1921	102,834.88	12,851.19	42,501.83	5,298.66	163,486.56
1922	95,929.95	11,550.61	60,362.74	8,580.22	176,423.52
1923	78,137.43	10,963.72	60,085.96	8,309.56	157,496.67

Rules and Regulations

The law provides that the state chemist shall have authority to make rules and regulations relating to the inspection, analyses and sale of fertilizers. In accordance with this authority, rulings have been made in the past, and they have been published several times. It does not seem necessary to repeat these rulings at this time

During the past year considerable study has been given to the large number of samples that were found deficient, and it seemed as if the deficiencies were increasing from year to year. On account of this condition, and in order to secure some redress for the purchaser, the following ruling was made tentative last June and was made official November 1.

Fertilizer Ruling

The trade value of the samples of fertilizer materials and mixed fertilizers will be determined by the use of the trade values adopted for the current year.

Any sample which has a deficiency of not more than 0.20 per cent of nitrogen, or 0.30 per cent of phosphoric acid, or 0.30 per cent of potash will be considered as substantially satisfying its guarantee.

In computing the trade value of a shipment of mixed goods containing two or more elements of plant-food that shows a deficiency of not more than 0.50 per cent in nitrogen, or 0.75 per cent in phosphoric acid, or 0.75 per cent in potash, over runs to the extent of 0.30 per cent of nitrogen, 0.50 per cent of phosphoric acid, or 0.50 per cent of potash will be included in the results. If the trade value, thus calculated for the shipment, is equal to the trade value of the product as guaranteed, the report shall state that the trade value has been delivered. If the trade value, however, has not been delivered, the report shall state the percentage difference in the values, and the manufacturer

is required to make a rebate to the purchaser, using the price charged for the material and the percentage difference in the trade values as stated for determining the amount of rebate per ton to be paid. This rebate is to be made and record filed with the State Chemist within 10 days from the date when the report is made official.

In the event that the full rebate has not been made and record filed as stated, the transaction will be studied and, if the conditions warrant, the question will be referred to the Attorney-General for action.

Should any shipment have a deficiency greater than 0.50 per cent in nitrogen, or 0.75 per cent in phosphoric acid, or 0.75 per cent in potash, *no* allowance will be made for over runs in computing the trade values. After allowing 10 days from the date the report is made official, all of the records relating to the shipment will be considered on their merits and, if the conditions warrant, the question will be referred to the Attorney-General for action.

TABLE 2

Wholesale Cost, Per Pound, in New York, of Essential Fertilizer Elements

Months—1923	Nitrogen in the Form of			Phosphoric Acid in the Form of Acid Phosphate	Potash in the Form of			
	Nitrate of Soda	Sulfate of Ammonia	Dried Blood		Muriate of Potash	Sulfate of Potash	Kainit	Manure Salts
	cents	*cents*	*cents*	*cents*	*cents*	*cents*	*cents*	*cents*
January	16.60	15.90	28.90	2.97	3.52	4.70	2.91	2.64
February	16.53	15.90	28.78	2.97	3.52	4.70	2.91	2.64
March	16.75	15.32	28.54	2.97	3.52	4.70	2.91	2.64
April	16.94	15.32	26.96	2.97	3.52	4.70	2.91	2.64
May	16.47	15.49	22.41	2.69	3.44	4.54	2.91	2.64
June	15.67	15.61	22.77	2.54	3.42	4.47	2.91	2.64
July	15.57	15.61	22.77	2.50	3.26	4.22	2.74	2.47
August	15.43	15.61	23.27	2.50	3.08	4.04	2.62	2.36
September	15.40	15.61	......	2.50	3.08	4.04	2.62	2.36
October	15.60	15.22	......	2.50	3.08	4.04	2.62	2.36
November	15.39	14.39	......	2.50	3.08	4.09	2.62	2.36
December	15.89	13.71	......	2.50	3.08	4.24	2.62	2.36
Average, 1923	16.02	15.31	25.61	2.68	3.30	4.37	2.78	2.51
Average, 1922	16.16	14.61	25.01	2.73	3.38	4.54	2.76	2.58
Average, 1921	15.78	11.63	11.92	4.04	5.17	7.47	3.39	3.29

Wholesale Prices of the Essential Elements of Plant-Food for 1923

The wholesale prices of the unmixed or raw materials used in preparing mixed fertilizers are quoted weekly in the trade journal, "The Oil, Paint and Drug Reporter."

In order to express the figures given as prices per pounds of actual plant-food, which is the form adopted by the various experiment stations, the quotations have been recalculated for the year 1923 and are given in table 2.

The Trade Value of the Essential Elements of Plant-Food

The station's valuations of the various fertilizers have not been published for several years, but, in order that they may be calculated by anyone interested, the following is the schedule of prices prepared for use at this office. When these figures are used it must be understood that results obtained will not give the selling price of a given mixed fertilizer. The figures secured will be the value of the elements if they were received from high-grade materials, and will not include the legitimate charges for mixing, bagging, commissions, interest, etc.

	Valuation— cents, per pound
Nitrogen from nitrates	20
Nitrogen from ammonia salts	20
Nitrogen, organic, in mixed fertilizers	31
Phosphoric Acid, soluble and reverted	5
Phosphoric Acid, insoluble, in mixed fertilizers	2
Potash soluble in water, as sulfate	6
Potash soluble in water, as muriate	4

Inspection

The inspection of the fertilizers sold requires: (1) information regarding the proper registration and branding, (2) the collection of the samples, (3) the chemical examinations, and (3) the reports showing the results secured.

Collection of Samples

If there is any one part of the inspection work which is more important than the others, it is the one relating to the collection of the samples, because, if a sample is not accurately taken, all of the subsequent work with the sample will lose its accuracy. Realizing this condition, every effort is made to have accurate samples. We have full confidence in the work of our two inspectors, who devote their entire time to this kind of work.

In order to make an efficient inspection, it is necessary to secure samples of as many brands as possible, and this can be accomplished only by the faithful and persistent work of the inspectors. It is quite probable that we do not secure samples of every brand sold, but, if this condition is found, it is due to the fact that our inspectors did not find the material when making the collection.

The material having been located, the next important question is the sampling. The law definitely prescribes the method for drawing

is required to make a rebate to the purchaser, using the price charged for the material and the percentage difference in the trade values as stated for determining the amount of rebate per ton to be paid. This rebate is to be made and record filed with the State Chemist within 10 days from the date when the report is made official.

In the event that the full rebate has not been made and record filed as stated, the transaction will be studied and, if the conditions warrant, the question will be referred to the Attorney-General for action.

Should any shipment have a deficiency greater than 0.50 per cent in nitrogen, or 0.75 per cent in phosphoric acid, or 0.75 per cent in potash, no allowance will be made for over runs in computing the trade values. After allowing 10 days from the date the report is made official, all of the records relating to the shipment will be considered on their merits and, if the conditions warrant, the question will be referred to the Attorney-General for action.

TABLE 2

Wholesale Cost, Per Pound, in New York, of Essential Fertilizer Elements

Months—1923	Nitrogen in the Form of			Phosphoric Acid in the Form of Acid Phosphate	Potash in the Form of			
	Nitrate of Soda	Sulfate of Ammonia	Dried Blood		Muriate of Potash	Sulfate of Potash	Kainit	Manure Salts
	cents	*cents*	*cents*	*cents*	*cents*	*cents*	*cents*	*cents*
January	16.60	15.90	28.90	2.97	3.52	4.70	2.91	2.64
February	16.53	15.90	28.78	2.97	3.52	4.70	2.91	2.64
March	16.75	15.32	28.54	2.97	3.52	4.70	2.91	2.64
April	16.94	15.32	26.96	2.97	3.52	4.70	2.91	2.64
May	16.47	15.49	22.41	2.69	3.44	4.54	2.91	2.64
June	15.67	15.61	22.77	2.54	3.42	4.47	2.91	2.64
July	15.57	15.61	22.77	2.50	3.26	4.22	2.74	2.47
August	15.43	15.61	23.27	2.50	3.08	4.04	2.62	2.36
September	15.40	15.61	......	2.50	3.08	4.04	2.62	2.36
October	15.60	15.22	......	2.50	3.08	4.04	2.62	2.36
November	15.39	14.39	......	2.50	3.08	4.09	2.62	2.36
December	15.89	13.71	......	2.50	3.08	4.24	2.62	2.36
Average, 1923	16.02	15.31	25.61	2.68	3.30	4.37	2.78	2.51
Average, 1922	16.16	14.61	25.01	2.73	3.38	4.54	2.76	2.58
Average, 1921	15.78	11.63	11.92	4.04	5.17	7.47	3.39	3.29

Wholesale Prices of the Essential Elements of Plant-Food for 1923

The wholesale prices of the unmixed or raw materials used in preparing mixed fertilizers are quoted weekly in the trade journal, "The Oil, Paint and Drug Reporter."

In order to express the figures given as prices per pounds of actual plant-food, which is the form adopted by the various experiment stations, the quotations have been recalculated for the year 1923 and are given in table 2.

The Trade Value of the Essential Elements of Plant-Food

The station's valuations of the various fertilizers have not been published for several years, but, in order that they may be calculated by anyone interested, the following is the schedule of prices prepared for use at this office. When these figures are used it must be understood that results obtained will not give the selling price of a given mixed fertilizer. The figures secured will be the value of the elements if they were received from high-grade materials, and will not include the legitimate charges for mixing, bagging, commissions, interest, etc.

	Valuation—cents, per pound
Nitrogen from nitrates	20
Nitrogen from ammonia salts	20
Nitrogen, organic, in mixed fertilizers	31
Phosphoric Acid, soluble and reverted	5
Phosphoric Acid, insoluble, in mixed fertilizers	2
Potash soluble in water, as sulfate	6
Potash soluble in water, as muriate	4

Inspection

The inspection of the fertilizers sold requires: (1) information regarding the proper registration and branding, (2) the collection of the samples, (3) the chemical examinations, and (3) the reports showing the results secured.

Collection of Samples

If there is any one part of the inspection work which is more important than the others, it is the one relating to the collection of the samples, because, if a sample is not accurately taken, all of the subsequent work with the sample will lose its accuracy. Realizing this condition, every effort is made to have accurate samples. We have full confidence in the work of our two inspectors, who devote their entire time to this kind of work.

In order to make an efficient inspection, it is necessary to secure samples of as many brands as possible, and this can be accomplished only by the faithful and persistent work of the inspectors. It is quite probable that we do not secure samples of every brand sold, but, if this condition is found, it is due to the fact that our inspectors did not find the material when making the collection.

The material having been located, the next important question is the sampling. The law definitely prescribes the method for drawing

Average Composition of Commercial Fertilizers

In order to compare the results obtained with those of the preceding nine years, table 5 has been prepared.

TABLE 5

Average Composition of Fertilizers for Ten Years

Year	Total Nitrogen	Total Phosphoric Acid	Available Phosphoric Acid	Insoluble Phosphoric Acid	Potash	Selling Price
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	
1914	2.66	9.24	7.75	1.49	6.91	$29.51
1915	2.70	9.78	8.19	1.59	3.54	30.95
1916	2.39	10.67	8.98	1.69	1.39	32.43
1917	2.63	10.51	8.73	1.78	1.83	34.35
1918	2.31	10.19	8.53	1.66	1.96	46.72
1919	2.10	10.03	8.58	1.45	2.24	58.73
1920	2.35	9.80	8.38	1.42	3.86	53.10
1921	2.46	9.83	8.49	1.34	4.26	54.10
1922	2.68	9.74	8.54	1.20	5.13	38.24
1923	2.71	9.49	8.28	1.21	5.48	35.69

Deficiencies

A study of the detailed reports will show that the guarantees were exceeded in some instances while in others a deficiency is noted. There were 117 brands which fully satisfied their guarantees and 204 brands which did not fully do so, but were substantially in the same class. There were 153 brands, or 32 per cent, deficient.

Table 6 shows the deficiencies that have been reported during the past ten years. In preparing this tabulation, deficiencies of 0.20 per cent or less of nitrogen, or 0.30 per cent of phosphoric acid or potash, have been disregarded.

In the 475 brands examined this year there were 1,398 deficiencies possible, and, of this number, 176, or 11.7 per cent, were found; these deficiencies, consisting of nitrogen 49, phosphoric acid 85 and potash 42, were distributed in 153 brands, 143 brands being deficient in one element and 10 brands in two elements.

This is a decided improvement on the report for the preceding inspection, and we believe that the future inspections will show still further improvement.

Shortly after the inspection for 1922 had been completed and the results tabulated, it was decided that some action must be taken in order to reduce, if possible, the large number of deficiencies that had been found during the past few years, the condition appearing to have a permanency. It was not desirable to make a drastic ruling without

a just cause, and, consequently, the question was taken up with every manufacturer on record The situation was very freely and thoroughly discussed by the different manufacturers. A great interest was shown by all of the manufacturers in an adequate solution of the problem. Two manufacturers were so interested that they not only investigated our work, including the preparation of the sample, but had a representative travel with our inspectors to supervise the drawing of samples. The department very readily complied with these suggestions of checking our work, and the information secured by the representatives permitted the manufacturers to inform us that they could not question the work when carried out in the manner observed.

TABLE 6

Comparison of Deficiencies From 1914 to 1923

Year	Record of Brands				Actual Deficiencies				
	Examined	Found as Guaranteed	Found Deficient	Percentage Deficient	Deficiencies Possible	Nitrogen	Phosphoric Acid	Potash	Percentage Found
1914	608	420	188	31	1,824	63	92	49	11.2
1915	543	367	176	32	1,629	94	83	31	12.8
1916	565	356	209	37	1,406	139	81	17	16.9
1917	552	380	172	31	1,360	85	88	15	13.8
1918	502	352	150	30	1,218	82	69	15	13.6
1919	556	388	168	30	1,396	98	73	17	13.5
1920	512	340	172	33	1,399	104	61	31	14.0
1921	516	342	174	34	1,462	89	65	43	13.5
1922	526	321	205	39	1,528	123	56	52	15.1
1923	475	322	153	32	1,398	49	85	42	11.7

After the suggestions of those interested had been carefully considered, a tentative ruling was made and no particular criticism was made. This ruling is now permanent, and it will be found in detail in this report.

It may be a coincidence, or the manufacturers may have taken more care in the preparation of their mixtures this year, but, irrespective of the cause, the important fact is that the materials delivered did not show so many deficiencies as in previous years. This is particularly noticeable in the nitrogen content; last year about 23 per cent of the brands were deficient in this costly element, while during the 1923 inspection but 10 per cent of the brands were deficient in this element. The deficiencies in potash were also reduced, but the good record was partially spoiled by an increase in the phosphoric acid deficiencies.

It is expected that the ruling referred to not only will have a good effect upon the character of the goods sold, but will also benefit the purchaser by any slight differences in the mixtures as purchased.

Quality of Plant-Food

The fertilizer law of this state requires a guarantee of the following: nitrogen, nitrogen equivalent to ammonia, available and total phosphoric acid, and water-soluble potash. The examinations made cover these guarantees, and, in addition, include the determinations for the amount of nitrogen in the form of nitrates, of ammonia salts and of soluble and insoluble organic nitrogen. The availability of the insoluble nitrogen is also determined by the alkaline permanganate method. This extended examination undoubtedly gives sufficient information to warrant judgment of the quality of the plant-food delivered.

The detailed results of these determinations are found in the tabulations. There were 307 brands which contained nitrogen in the form of nitrates, 428 brands contained ammonia salts and 266 brands contained both of the water-soluble forms. A comparison of these figures, with those of the previous inspection, makes it quite apparent that there was a larger use of these forms of nitrogen this year. The availability of the insoluble organic nitrogen was determined in all of the samples containing organic nitrogen. The results show that 73, or 15.3 per cent, of the brands contained an inferior grade of material, although some of these brands contained only a small amount of this grade. Forty-three of these brands contained more total nitrogen than was guaranteed, the excess being sufficient in 15 brands to offset the amount of inferior quality, and in 28 brands to offset partially the amount present as an inferior quality. Last year 10.4 per cent of the brands contained nitrogen in an inferior form. The increased use of the low grade of organic nitrogen and of the nitrate of soda and sulfate of ammonia were to be expected on account of the shortage of high-grade organic nitrogen for fertilizer purposes.

The Purchase of Fertilizers

Fertilizers are purchased because they contain a certain amount of plant-food in the form of nitrogen, phosphoric acid and potash. The cost of the fertilizer is determined by the number of pounds of plant-food contained, together with the charge for mixing, bags, freight and profit. The charge for mixing and bags is the same for all grades of mixtures, and the cost of freight and carting will depend upon the number of tons secured, irrespective of the number of pounds of plant-food contained.

Since the charge for mixing and bagging is the same for all mixtures, it should be readily seen that a pound of plant-food in a low-analysis fertilizer costs more money than a pound of plant-food in a high-analysis fertilizer. It is very obvious that everyone should purchase the plant-food required by selecting high-analysis goods.

It is quite evident that many of the farmers in this state realize this important fact, because the records show that but a small percentage of the brands sold have a low analysis.

A summary has been prepared of the brands sold this year, and, if we consider a brand containing 12 units or less as a low-analysis grade, one containing from 12 to 14 units as a medium-analysis grade, and one containing over 14 units as a high-analysis grade, the following will show the percentage of brands in each grade that was sold:

Low-analysis	5.0 per cent
Medium-analysis	21.0 per cent
High-analysis	74.0 per cent

Ground Bone

Thirty-five samples of ground bone were examined during the inspection, the results being tabulated. Table 7 gives the average composition and selling price for the past ten years.

TABLE 7

Average Composition of Ground Bone

Year	Fine Bone	Coarse Bone	Nitrogen	Phosphoric Acid	Selling Price
	per cent	*per cent*	*per cent*	*per cent*	
1914	60.0	40.0	2.82	23.24	$42.40
1915	57.0	43.0	2.96	23.77	33.50
1916	53.0	47.0	2.80	23.80	39.50
1917	58.0	42.0	2.95	24.28	38.82
1918	59.0	41.0	2.85	24.84	48.49
1919	58.0	42.0	2.93	24.82	54.71
1920	58.0	42.0	2.97	25.06	54.23
1921	53.0	47.0	3.12	24.40	54.80
1922	51.5	48.5	3.17	24.11	42.16
1923	49.0	51.0	3.21	23.87	49.00

V. INSPECTION OF AGRICULTURAL LIME DURING 1923

The detailed results of this inspection were published in bulletin 395.

Registrations

During the year 1923, 44 manufacturers registered 90 different brands of agricultural lime.

Inspection

A comparatively large number of samples of the lime products were examined and duly reported. Many of these samples were forwarded by individuals and could not be considered official samples.

TABLE 8

Summary of the Results Obtained with the Mixed Fertilizers Examined During the Inspection of 1923

Manufacturer	Address	Number of Brands Received	Number of Samples Examined	Number of Samples Satisfied Guarantees	Number of Samples Substantially Satisfied Guarantees	Number of Samples Deficient in: Nitrogen	Phosphoric Acid	Potash	One Element	Two Elements	Three Elements
Acme Guano Co.	Baltimore, Md.	12	12	4	3	1	5	....	4	1	....
American Agricultural Chemical Co.	New York City	80	91	28	52	1	9	1	11	....	....
American Fertilizing Co.	Baltimore, Md.	3	3	2	....	....	1	....	1	....	....
Armour Fertilizer Works	New York, N. Y.; Chrome and Carteret, N. J.	12	16	1	13	2	....	....	2	....	....
Baugh & Sons Co.	Philadelphia, Pa.	*26	31	11	12	3	....	3	6	....	....
G. A. Bennett	Hightstown, N. J.	2	2	....	2	....	....	....	....	....	....
Bennett & Denison	Prospect Plains, N. J.	1	1	1	....	....	....	....	....	....	....
Bon Arbor Chemical Co.	Paterson, N. J.	1	1	1	....	....	....	....	....	....	....
Bone Dry Lime Corporation	Cassadaga, N. Y.	1	1	....	1	....	....	....	....	....	....
Bowker Fertilizer Co.	New York City	13	16	5	8	....	2	1	3	....	....
Wm. M. Brown & Son	Cedarville, N. J.	1	1	1	....	....	....	....	....	....	....
Chamberlain & Barclay	Cranbury, N. J.	4	4	2	1	....	....	1	1	....	....
Coe-Mortimer Co.	New York City	11	13	3	9	....	....	1	1	....	....
J. S. Collins & Son, Inc.	Moorestown, N. J.	5	5	2	2	1	....	....	1	....	....
Consumers Chemical Corporation	New York City	2	2	1	1	....	....	....	....	....	....
Cooperative Growers' Association	Beverly, N. J.	4	4	3	1	....	....	....	....	....	....

* Two special mixtures.

TABLE 8—Continued

Summary of the Results Obtained with the Mixed Fertilizers Examined During the Inspection of 1923

Manufacturer	Address	Number of Brands Received	Number of Samples Examined	Number of Samples Satisfied Guarantees	Number of Samples Substantially Satisfied Guarantees	Number of Samples Deficient in: Nitrogen	Phosphoric Acid	Potash	One Element	Two Elements	Three Elements
J. G. Downward Co.	Coatesville, Pa.	3	3	2	1	....	....	....	....	....	....
Dumont Fertilizer Co.	Philadelphia, Pa.	7	7	.....	1	4	2	3	3	3	.....
Farmers' Cooperative Association of Cape May County	Rio Grande, N. J.	3	3	1	2	....	....	....	....	....	....
Farmers' Cooperative Association of Mercer County	Trenton, N. J.	1	1	.....	.....	....	....	1	1	....	....
Fogg & Hires Co.	Salem, N. J.	1	1	.....	.....	1	....	....	1	....	....
Alex. Forbes & Co.	Newark, N. J.	2	2	1	.....	....	....	1	1	....	....
Godfrey Fertilizer & Chemical Co.	Newark, N. J.	2	3	.....	2	1	....	....	1	....	....
Grange Commercial Store	Bridgeton, N. J.	6	6	.....	2	3	1	....	4	....	....
Chas. A. Green & Son	Philadelphia, Pa.	4	4	.....	2	....	2	....	2	....	....
Thos. Y. Hackett	Daretown, N. J.	1	1	.....	.....	....	....	1	1	....	....
Hackett & Garrison Fertilizer Co.	Daretown, N. J.	9	11	.....	5	1	....	5	6	....	....
Hendrickson & Dilatush	Robbinsville, N. J.	4	4	3	1	....	....	....	....	....	....
Heritage & Bros.	Mullica Hill, N. J.	4	4	1	1	....	2	....	2	....	....
S. W. Hess & Bro., Inc.	New York City	10	12	4	8	....	....	....	....	....	....
Hill Bros.	Flemington, N. J.	2	2	1	1	....	....	....	....	....	....
Hubbard Fertilizer Co.	Baltimore, Md.	5	5	.....	3	....	1	1	2	....	....
Hunterdon County Farmers' Cooperative Association	Flemington, N. J.	6	6	2	1	....	2	1	3	....	....
H. B. Kemp	Long Branch, N. J.	6	6	1	1	2	1	2	3	1	.....

TABLE 8—Continued

Summary of the Results Obtained with the Mixed Fertilizers Examined During the Inspection of 1923

Manufacturer	Address	Number of Brands Received	Number of Samples Examined	Number of Samples Satisfied Guarantees	Number of Samples Substantially Satisfied Guarantees	Number of Samples Deficient in: Nitrogen	Phosphoric Acid	Potash	One Element	Two Elements	Three Elements
Keystone Bone Fertilizer Co.	Philadelphia, Pa.	4	6	....	4	....	2	....	2	....	....
S. Lederer & Son	New Brunswick, N. J.	2	2	....	....	....	2	....	2	....	....
F. Leonelli	Landisville, N. J.	3	3	1	2	....	....	....	....	....	....
Mapes F. & P. Guano Co.	New York City	6	6	3	2	1	....	....	1	....	....
A. Mitchell	Newark, N. J.	2	2	....	1	....	1	....	1	....	....
Monmouth County Farmers' Exchange	Freehold, N. J.	4	4	2	1	....	1	....	1	....	....
J. R. Moore & Son	Swedesboro, N. J.	7	7	1	4	1	....	1	2	....	....
National Oil and Supply Co.	Newark, N. J.	2	2	....	1	....	....	1	1	....	....
A. Nelson	Allentown, N. J.	4	6	4	1	....	1	....	1	....	....
Nitrate Agencies Co.	Bound Brook, N. J.	3	3	....	....	2	....	1	3	....	....
Peerless Fertilizer Co.	Chestertown, Md.	3	3	....	....	2	....	1	3	....	....
Philadelphia Guano Works	Philadelphia, Pa.	5	5	1	1	....	3	....	3	....	....
Piedmont-Mt. Airy Guano Co.	Baltimore, Md.	1	1	....	....	1	....	....	1	....	....
Rasin-Monumental Co.	Baltimore, Md.	12	16	4	4	....	8	....	8	....	....
Reading Bone Fertilizer Co.	Reading, Pa.	4	4	2	....	1	....	1	2	....	....
Reed & Perrine	Tennent, N. J.	2	2	1	1	....	....	....	....	....	....
R. A. Reichard, Inc.	Allentown, Pa.	2	2	....	....	....	1	2	1	1	....
Rooney & Ely	Englishtown, N. J.	1	1	....	1	....	....	....	....	....	....
F. S. Royster Guano Co.	Baltimore, Md.	13	16	2	9	2	3	....	5	....	....
Schanck, Hutchinson & Field	Hightstown, N. J.	1	1	....	1	....	....	....	....	....	....
Scott Fertilizer Co.	Elkton, Md.	3	3	....	1	1	1	....	2	....	....

TABLE 8—Continued

Summary of the Results Obtained with the Mixed Fertilizers Examined During the Inspection of 1923

Manufacturer	Address	Number of Brands Received	Number of Samples Examined	Number of Samples Satisfied Guarantees	Number of Samples Substantially Satisfied Guarantees	Number of Samples Deficient in: Nitrogen	Phosphoric Acid	Potash	One Element	Two Elements	Three Elements
I. Serata & Son	Bridgeton, N. J.	5	5	1	....	3	....	2	3	1	....
M. L. Shoemaker & Co., Inc.	Philadelphia, Pa.	10	10	2	4	1	3	....	4	....	....
South Jersey Farmers' Exchange	Woodstown, N. J.	7	8	3	4	1	....	....	1	....	....
Swedesboro Supply Co.	Swedesboro, N. J.	6	6	....	2	....	3	1	4	....	....
Swift & Co.	Baltimore, Md.	22	28	4	17	3	1	3	7	....	....
Taylor Bros.	Camden, N. J.	2	2	1	1	....	....	....	....	....	....
I. P. Thomas & Son Co.	Philadelphia, Pa.	14	14	5	3	....	6	....	6	....	....
Trenton Bone Fertilizer Co.	Trenton, N. J.	14	18	7	6	1	3	2	4	1	....
F. W. Tunnell & Co., Inc.	Philadelphia, Pa.	17	22	6	4	1	12	1	10	2	....
U. S. Guano Co.	Baltimore, Md.	2	2	....	....	....	....	2	2	....	....
Virginia-Carolina Chemical Co.	New York City	19	23	4	14	3	2	1	4	1	....
West Jersey Marl and Transportation Co.	Woodbury, N. J.	10	11	1	6	2	1	1	4	....	....
William Wilde	Vineland, N. J.	1	1	1	....	....	....	....	....	....	....
Woodstown Ice and Coal Co.	Woodstown, N. J.	4	4	....	1	3	....	....	3	....	....
A. Worthley	Marlboro, N. J.	1	2	....	2	....	....	....	....	....	....
J. R. Wyckoff	Princeton Jct., N. J.	3	3	....	3	....	....	....	....	....	....

VI. INSPECTION OF COMMERCIAL FEEDING STUFFS DURING 1923

The detailed results of the inspection of commercial feeding stuffs were published in bulletin 399.

Amendment to the Law

The law entitled, "An act concerning commercial feeding stuffs," was approved on March 28, 1912. Section one defined the term "feeding stuffs" and noted certain materials which were not to be included. One class of material "containing 60 per centum or more of water" was exempted, but, during the more recent years, certain materials of this class have become quite popular, and were being sold under conditions which seemed to require attention. In order to meet these conditions, section one of the law was amended during the 1923 session of the Legislature, and this section, as amended, is as follows:

Chapter 30, Laws of 1923

An act to amend an act entitled "An act concerning commercial feeding stuffs," approved March twenty-eighth, one thousand nine hundred and twelve.

BE IT ENACTED BY THE SENATE AND GENERAL ASSEMBLY OF THE STATE OF NEW JERSEY:

1. Section one of the act to which this act is an amendment is hereby amended so as to read as follows:

1. The term "commercial feeding stuffs" shall be held to include all feeding stuffs used for feeding live stock and poultry, except whole seeds or grains sold as such, and the unmixed meals made directly from, and composed of, the entire grains of corn, wheat, rye, barley, oats, buckwheat, flaxseed, kafir and milo; neither shall it include whole hays, straws, cottonseed hulls and corn stover when unmixed with other materials, nor shall it include wet brewers' grains.

2. This act shall take effect immediately.

Purpose of the Law

The purpose of the law is to require each feeding stuff to be sold upon its own merits, and, consequently, the law provides protection to the honest manufacturer as well as to the consumer. A manufacturer should know what he is selling and the dealer or consumer is entitled to know what he is buying.

In order to secure the maximum benefits of the law, dealers and consumers should be familiar with the terms "crude protein," "crude fat" and "crude fiber." With this information available, the statements attached to the feed should be carefully studied in order to know the exact guarantee and what it means. If the feed is a mixture, a careful examination should also be made of the ingredients claimed to be present.

Registrations

The law requires an annual registration on January 1 of the brands that will be offered for sale during the year. Unfortunately, in many instances, this requirement is not taken care of as promptly as it should be, and, as a result, the registrations are delayed.

During the year 1923, 455 manufacturers and brokers registered 2,190 brands which they desired to sell in New Jersey. Our inspectors found a number of brands being offered for sale which had not been registered, and this condition necessitated stopping the sale of the material until the requirement had been complied with. The registrations were eventually made for most of these brands. There appear to be two causes for this condition, one of which is negligence on the part of the manufacturer for which there is no excuse, and the other is that some local person decides to mix and sell to nearby trade in a small way, and, without securing the proper information before sales are made, finds out later the method he must follow. While there were a number in the latter class, the total tonnage represented was very small.

TABLE 9

Summary of Tonnage Reports

YEAR	July Reports	January Reports	Total for Year
	tons	*tons*	*tons*
1914	88,192.50	114,508.73	202,701.23
1915	103,626.91	124,563.34	228,190.25
1916	111,910.84	123,437.16	235,348.00
1917	114,939.37	119,101.06	234,040.43
1918	108,771.45	121,635.23	230,406.68
1919	102,837.34	144,052.15	246,889.49
1920	120,156.78	135,897.75	256,054.53
1921	123,752.97	154,187.88	277,940.85
1922	134,876.65	159,965.17	294,841.82
1923	140,470.08	182,934.01	323,404.09

Tonnage of Feeding Stuffs Sold

Manufacturers and those responsible for feeding stuffs sold in this state are required to render reports on July 1 and January 1 of each year showing the total tonnage sold during the six months preceding these dates. These reports do not show the tonnage of each brand or material, but simply show the total tonnage. Table 9 is a summary of the reports received during the past ten years.

Inspection

During the inspections a total of 1,388 samples were received, 200 of these samples being forwarded by individuals and the other samples being collected by our inspectors.

In order to make the inspections as thorough as possible, the inspectors are supplied with carefully-prepared itineraries which include every county in the state. The inspectors followed these itineraries quite closely, and, as a result, the official samples represented the stock of 276 dealers and consumers who were located in 180 different cities and towns. The stock of many other dealers and consumers was examined as to the branding but were not sampled, because the same brands had been sampled at nearby places.

Examination of Feeding Stuffs

The examination of the feeding stuffs herewith reported consisted of a microscopical examination, and a chemical analysis.

The microscopical examination was for the purpose of determining the various materials in the feeds in order to check the statements on the shipment.

The chemical examinations made included the determinations for moisture, crude protein, crude fat and crude fiber. A complete examination would have included a determination of the ash content, and, with this result, would permit a statement as to the content of nitrogen-free extract. A feeding stuff is composed of groups of chemical compounds which have certain functions to perform in the production of energy and in maintaining or building up the animal body. The following will give a brief explanation of these groups:

Moisture or Water. Moisture in feeds is the water found in all grains and feeding stuffs. The amount of water present is variable, depending upon the kind of feeding stuff, its age, the method of preparation and storing. No close comparison of the value of feeding stuffs can be made unless the results are computed on a moisture-free basis.

Crude Protein. Protein is a term which includes all the nitrogenous compounds of a feed regardless of their nature. The term "protein," as used in this report, simply means the total nitrogen content multiplied by the factor 6.25. It is the most important nutrient in a feeding stuff, and usually is the most expensive to purchase.

With feeding stuffs of the same class it is generally accepted that the more protein it contains the better its quality. It is not possible, however, to compare feeding stuffs of different classes by the protein content alone. A comparison of such feeds must include the fat and carbohydrates, since they have a great value.

Crude Fat. Fat, or more correctly called "ether-extract," consists of the fat as well as small quantities of wax, coloring matter and other substance which may be extracted from a dry feed by anhydrous ether. Fat ranks second in value as a nutrient. An excess of fat tends to retard digestion and, in certain cases, the material becomes moldy and unpalatable.

Crude Fiber. Fiber or crude fiber is the structural or woody part of the hay, grain or feeding stuff. Ordinarily, a feeding stuff having a high content of crude fiber is classed as a low-grade feed. Since the purchaser can usually

produce a sufficient quantity of home-grown roughage, it is not economical for him to buy feeding stuffs containing a high percentage of crude fiber.

Nitrogen-Free-Extract. Nitrogen-free-extract includes such materials as starch, sugar, gums and other bodies of similar nature, and is the general term given to those bodies other than water, protein, fat, fiber and ash contained in a feed.

Ash. Ash is the mineral constituent of a feed, and consists largely of phosphate and carbonate of calcium and potassium. Ash is valuable to the animal because it furnishes the material for the formation of bones. An excessive amount of ash in a feed indicates a contamination with dirt or sand.

Results of the Examination

Every brand collected by our inspectors is subjected to a microscopical and chemical examination. The results secured were duly reported to the manufacturer and to the party having the material in stock from which the sample was taken. If the sample satisfied the guarantees given, the two reports were submitted on the same day, but, if the sample was deficient, the report was sent to the manufacturer and he was allowed ten days to check the report if he so desired. At the expiration of the ten days the report was made official and sent to the purchaser of the material.

TABLE 10

Summary of Deficiencies

INSPECTION	Samples Examined	Samples Deficient	Samples Deficient in:		
			Protein	*Fat*	*Fiber*
		per cent	*per cent*	*per cent*	*per cent*
1915	920	17.2	6.7	6.8	6.6
1916	1102	26.6	9.3	9.3	14.0
1917	1103	32.3	10.0	9.3	19.6
1918	932	27.9	9.2	8.9	16.2
1919	810	22.1	9.6	4.6	12.0
1920	822	20.8	8.0	7.2	9.5
1921	863	15.4	7.9	7.0	3.3
1922	927	18.9	9.5	7.2	5.7
1923	948	12.6	6.0	7.2	1.3
1924	975	21.2	7.7	7.4	9.9

All of the unofficial samples (200) were examined and reports sent to the parties sending the samples.

There were 1,003 official samples examined and the results were published in the bulletin. Twenty-eight of these samples were not accompanied by the required guarantees, and the parties having the materials were notified not to sell the same until the information had been attached.

The results of the examination of the 975 guaranteed samples show that 539 fully satisfied the guarantees given for the minimum content

of protein and fat and the maximum content of fiber, and, in addition, there were 229 samples which substantially satisfied the guarantees given. There were 207, or 21.2 per cent, of the samples deficient. The deficiencies found consisted of the following: protein, 75; fat, 72; fiber, 96. There were 175 samples deficient in the one nutrient, 28 samples in two nutrients and 4 samples in the three nutrients.

A comparison of the number of deficiencies found during the last ten inspections is given in table 10.

It will be noted from table 10 that the results for the year 1923 are not so good as for the two preceding years. A study of the records will show that a large proportion of the deficiencies was found in the products prepared by the small local manufacturers of this state who sell but a comparatively few tons in the year to nearby trade. This condition is unfortunate and is caused, in part, at least, by inaccurate guarantees and poor mixing. The New Jersey manufacturers were responsible for 312 of the guaranteed brands, 91, or 29.1 per cent, being deficient. If the products of these local manufacturers were eliminated, including the products of the larger manufactures of the state with those of the out-of-state manufacturers, the average of deficient samples would be reduced to 12.7 per cent.

This condition should cause all of the local manufacturers to use more care in the preparation of their brands, in order that their purchasers may secure the material for which they pay.

Selling Prices

Our inspectors, at the time of drawing the samples, endeavor to secure the prices paid for the shipments represented, but, for various reasons, they are not always successful in getting the information. This will account for the absence of the statement of the average selling price of certain of the feeding stuffs tabulated in the summary of the inspection.

In order to compare the average selling prices for the past year with those of the 6 previous inspections, table 11 has been prepared showing these average prices for several of the more important feeding stuffs.

From the averages given above it is quite apparent, even if it had not been realized by experience, that there has been no decrease since the last report in the prices of the materials tabulated, with the exception of dried beet pulp and linseed oil meal.

Summary of the Inspection

Table 12 gives the summary of the inspection for 1923. The average composition of the mixtures is not given because of the variable composition of the individual samples. In securing the results which appear under the heading "number of samples substantially satisfied guarantees," it was considered that a sample was in this class if it was not more than 1 per cent low in protein or ½ per cent low in fat or ½ per cent high in fiber.

TABLE 11

Comparison of the Average Retail Selling Prices

	Average per ton during Inspection						
	1918	1919	1920	1921	1922	1923	1924
Alfalfa meal	$47.00	$51.00	$56.50	$53.00	$42.43	$44.00	$49.33
Brewers' dried grains	52.80	63.80	66.20	64.50	31.16	42.58	56.66
Buckwheat middlings	51.22	54.40	53.40	56.00	35.86	40.00	42.50
Corn gluten feed	59.28	58.00	74.40	67.33	42.33	48.04	53.30
Cottonseed meal	59.00	65.00	85.35	64.59	54.25	58.16	60.86
Dried beet pulp	49.25	53.00	58.33	63.42	37.00	56.33	48.09
Hominy feed	65.43	63.40	67.30	57.63	33.28	38.75	47.44
Linseed oil meal	60.07	63.80	83.45	65.07	48.64	57.71	55.38
Poultry meal	96.40	109.00	105.80	116.04	86.50	86.05	87.54
Rye bran	42.80	46.80	49.90	48.33	27.00	31.00	33.50
Rye feed	43.00	49.60	69.00	63.00	31.50	35.50	42.00
Rye middlings	50.68	54.00	59.80	60.46	32.00	31.00	36.00
Wheat bran	45.37	46.40	52.14	51.59	29.11	35.66	40.02
Wheat feed	46.60	44.80	58.40	61.60	31.62	36.63	39.75
Wheat feeding flour	68.00	57.80	75.60	77.00	47.05	43.56	47.43
Wheat middlings	57.12	50.20	65.75	63.30	36.00	38.37	43.68

TABLE 12

Summary of the Results of the Inspection

	Number of Samples	Average Composition				Average Retail Selling Price Per Ton	Number of Samples Satisfied Guarantees	No. of Samples Substantially Satisfied Guar.	Number of samples deficient in:					
		Water	Protein	Fat	Fiber				Protein	Fat	Fiber	One Nutrient	Two Nutrients	Three Nutrients
Alfalfa Meal	9	7.71	14.69	1.65	27.93	$49.33	7	1	....	1	....	1	....	....
[1]Brewers' Dried Grains	6	6.84	23.41	6.88	14.67	56.66	3	1	....	....	1	1	....	....
Brewery Products	3	......	......	......	......	......	3	....	....	....	....	....	....	....
[1]Buckwheat Feed	3	13.87	22.86	5.70	3.18	34.50	....	....	2	....	....	2	....	....
[1]Buckwheat Middlings	3	13.36	29.98	7.47	7.03	42.50	2	....	....	....	....	....	....	....
Buckwheat Offal	1	8.54	14.94	3.31	21.18	......	....	1	....	....	....	....	....	....
[1]Buckwheat Screenings	1	12.71	11.75	2.88	5.45	......	....	....	....	....	....	....	....	....
Calf Meal	6	......	......	......	......	85.43	3	2	1	....	....	1	....	....
Cocoanut Oil Meal	2	5.60	21.69	10.31	10.16	44.00	....	1	....	....	1	1	....	....
Corn and Cob Meal	5	12.08	7.66	3.41	5.14	31.00	3	....	....	....	2	2	....	....
[1]Corn and Oats	15	10.12	11.02	4.43	4.93	46.46	9	1	....	1	4	3	1	....
Corn Distillers' Dried Grains	1	4.63	29.94	11.52	9.30	64.00	....	1	....	....	....	....	....	....
Corn Feed Meal	7	10.68	9.49	4.33	2.40	49.80	6	1	....	....	....	....	....	....
Corn Gluten Feed	10	7.97	24.89	2.54	7.01	53.30	10	....	....	....	....	....	....	....
Corn Gluten Meal	1	7.45	44.19	2.56	2.68	......	1	....	....	....	....	....	....	....
[1]Cottonseed Meal	26	6.72	39.79	6.73	10.65	60.86	4	13	8	....	3	5	3	....
[3]Dried Beet Pulp	10	8.60	7.66	0.56	17.76	48.09	2	4	....	....	1	1	....	....
Dried Blood	1	13.58	78.25	......	*0.30	......	....	....	1	....	....	1	....	....
Dried Malt Grains	4	5.64	24.08	8.08	14.75	42.75	3	....	1	1	1	....	....	1
Feed Mixtures	176	......	......	......	......	48.38	94	47	10	8	19	33	2	....

TABLE 12—Continued

Summary of the Results of the Inspection

	Number of Samples	Average Composition				Average Retail Selling Price Per Ton	Number of Samples Satisfied Guarantees	No. of Samples Substantially Satisfied Guar.	Number of samples deficient in:					
		Water	Protein	Fat	Fiber				Protein	Fat	Fiber	One Nutrient	Two Nutrients	Three Nutrients
[4]Feed Mixtures (New Jersey manufacturers)	90	.....	.....	.....	.....	$45.04	30	29	10	12	14	20	5	2
Fish Meal	3	7.02	56.35	8.94	*7.68	80.33	1	1	1	....	....	1	....	....
Hominy Feed	17	8.88	10.89	6.28	3.75	47.44	13	1	....	3	....	3	....	....
Linseed Oil Meal	13	8.06	31.06	7.08	8.21	55.38	7	3	3	....	....	3	....	....
Milk Products—														
Dried Milk Albumin	1	8.54	40.13	.....	.....	148.00	1	....	....	....	....	....	....	....
Dried Buttermilk	3	10.11	29.81	.....	.....	219.25	.....	1	2	....	....	2	....	....
Semi-Solid Buttermilk	1	71.52	10.81	.....	.....	100.00	.....	....	1	....	....	1	....	....
Lactein	1	81.02	11.43	.....	.....	.....	.....	1	....	....	....	....	....	....
Oat Feed	2	6.25	6.25	2.19	25.17	29.33	1	....	1	....	....	1	....	....
Oat Groat Nutriment	2	7.13	15.94	6.18	3.13	60.00	2	....	....	....	....	....	....	....
Oat Meal	3	7.01	15.92	6.62	1.72	63.00	.....	2	....	....	....	....	....	....
Oat Middlings	1	6.93	17.44	6.23	5.42	48.00	1	....	....	....	....	....	....	....
Oats, rolled	1	7.30	15.94	6.53	0.92	65.00	.....	1	....	....	....	....	....	....
Palmo Midds	1	5.87	15.88	8.82	6.44	42.00	.....	1	....	....	....	....	....	....
[1]Poultry Feed	192	.....	.....	.....	.....	60.59	123	44	10	12	3	23	1	....
[5]Poultry Feed (New Jersey manufacturers)	194	.....	.....	.....	.....	55.44	94	38	10	24	28	44	9	....
Poultry Meat	35	5.83	48.80	12.34	*10.40	87.54	19	8	7	1	....	8	....	....

TABLE 12—Continued

Summary of the Results of the Inspection

	Number of Samples	Average Composition				Average Retail Selling Price Per Ton	Number of Samples Satisfied Guarantees	No. of Samples Substantially Satisfied Guar.	Number of samples deficient in:					
		Water	Protein	Fat	Fiber				Protein	Fat	Fiber	One Nutrient	Two Nutrients	Three Nutrients
Rye Bran	3	10.77	14.69	3.25	3.99	$33.50	2	1	....	....	....	....	....	....
Rye Feed	1	9.36	15.19	3.19	3.93	42.00	1	....	....	....	....	....	....	....
Rye Middlings	4	11.70	11.80	2.51	2.45	36.00	2	....	2	2	....	....	2	....
Tankage Digester	2	5.69	49.66	12.54	*6.98	77.50	....	1	1	....	....	1	....	....
[2]Wheat Bran	70	8.53	15.41	4.80	9.75	40.02	49	8	1	....	11	10	1	....
Wheat Bran Scourings	1	8.50	8.94	2.41	21.11	12.00	....	....	1	1	1	....	....	1
Wheat Feed	9	8.74	15.99	5.05	7.58	39.75	7	2	....	....	....	....	....	....
[1]Wheat Feeding Flour	10	9.58	16.34	4.28	2.87	47.43	4	4	1	....	1	....	1	....
[1]Wheat Middlings	52	9.61	16.26	4.84	5.26	43.68	32	10	1	6	5	6	3	....
Wheat and Rye Middlings	1	10.05	15.56	4.10	5.01	45.50	....	....	....	....	1	1	....	....

*Total Phosphoric Acid.
[1]One sample not guaranteed.
[2]Two samples not guaranteed.
[3]Three samples not guaranteed.
[4]Four samples not guaranteed.
[5]Nine samples not guaranteed.

Report of the Division of Horticulture

M. A. Blake

The investigational work in the horticultural division in 1924 was featured by a considerable number of outstanding results.

In the early fall a Belle of Georgia x Greensboro peach seedling, which had resulted from station crosses in an effort to secure better varieties of peaches for New Jersey, was named "Pioneer." About 10,300 buds of this variety were distributed in August to New Jersey nurserymen and fruit growers, and in the early spring of 1924 about 2,200 trees grown in the station nursery were distributed among 107 growers in the state. In addition, 28 other promising seedlings were distributed among 49 growers. More than one thousand little seedlings from the crosses of 1923 were growing in the nursery in the early spring of 1924. Many promising seedlings which originated as early as 1915 and 1916 are continuing to fruit, and some of the best have reached a point where they will be named and introduced within the next year or two. The time when New Jersey fruit growers will have better varieties than Carman and Hiley is at hand. The horticultural division of the station now has growing upon its grounds the greatest known collection of species, varieties and types of peaches anywhere in the world. During the past year 33 additional varieties were added to the collection. *Prunus mira* is producing fruit upon the grounds for the first time this year.

A detailed study of peach blooms in the early spring of 1924 revealed the fact that calyx, sepal, receptacle and stem characters were valuable factors in distinguishing varieties and species. Special pruning experiments upon budded trees in the nursery seemed to indicate that the pruning of the top may have an influence upon the type of growth of the root. Extensive peach thinning experiments by the pomology department at Bridgeton furnished evidence as to important fundamentals in this practice. The use of the station spray mixture called "Dry-Mix" continued to be successful on peaches, and proved to be a valuable summer fungicide for apples following the petal fall spray.

The work with French hydrangeas was continued and information as to the best way to treat the soil in order to secure flowers of blue color where pink flowers had been produced previously were secured.

Treatment of a section of a propagating bed for carnations with potassium permanganate stimulated root development.

The station dahlia collection was increased during the year to about 370 varieties. The iris collection was increased to 200 varieties and a peony collection of 41 varieties donated.

Fertilizer studies with Columbia roses in the greenhouse indicated that topsoil from a fertile field, composted with 20-25 per cent of cow manure, does not require additional chemical fertilizers when roses are first benched in the greenhouse.

Plant-food studies with cauliflower at the north Jersey project in Passaic County gave some rather marked results. The vegetable department also started an extensive plant-food project with asparagus at Mickleton, N. J.

An apple introduced from the Ottawa Experiment Station at Ottawa, Canada, and known as Melba, first fruited upon the station grounds in the summer of 1923. It gives promise of being of much value as a commercial variety in New Jersey.

A considerable number of other introduced plants showed promising developments during the year, and many minor results of investigations were obtained which were not listed here.

REPORT OF DEPARTMENT OF POMOLOGY

ARTHUR J. FARLEY

The experimental work under the direction of the department of pomology has been conducted along the same lines as last year. The most important projects included spraying and dusting of peaches and apples, fertilization of apples, budding and distribution of peach seedlings, and peach thinning. Several new projects were outlined and started during the spring of 1924 with special reference to grapes and small fruits.

Spraying Experiments with Peaches

The spraying and dusting experiments carried on during the season at the Seabrook Orchards, Bridgeton, included the following treatments on Carman, Lola, Hiley, Belle, Elberta and Iron Mountain:

1—Atomic Sulfur 5 pounds to 50 gallons of water
2—Dry-Mix Sulfur Lime 2-4-50
3—Dry-Mix Sulfur Lime 4-4-50
4—Dry-Mix Sulfur Lime 6-4-50
5—Dry-Mix Sulfur Lime 8-4-50 (standard)
6—Check. No spray after dormant application.

Powdered lead arsenate at the rate of 1½ pounds to 50 gallons of mixture was added to each treatment in the shuck fall application and again two weeks later. Stone lime at the rate of 5 pounds to 50 gallons of mixture was used with the Atomic Sulfur, and lead arsenate in the shuck fall and following applications. The entire orchard received a dormant application of concentrated lime-sulfur 1 to 9. Starting with the shuck fall application on May 10, 5 applications were made to all varieties except Carman and Lola, which had 4, the

last application being omitted with these two varieties, because of their early ripening.

The chief object of this experiment was to compare Dry-Mix Sulfur Lime prepared with various amounts of sulfur with Standard Dry-Mix and Atomic Sulfur. This object was defeated because of the failure of scab and brown rot to develop on any of the sprayed fruit on account of the exceptionally dry season. However, some rather interesting results were secured from the standpoint of spray injury. All of the mixtures containing a relatively low percentage of sulfur injured the leaves and new twig growth. The most severe injury occurred on the blocks sprayed with Atomic Sulfur and 2-4-50 Dry-Mix. The trees in these blocks were so badly defoliated that the growth of the fruit was checked, a large percentage of the Carman, Lola and Hiley failing to reach a marketable size. The injury was quite noticeable on the 4-4-50 Dry-Mix block, the defoliation being sufficient to check slightly the growth of the fruit, but not enough to make it unmarketable. The injury on the 6-4-50 Dry-Mix block was much less than on 2-4-50 and 4-4-50 blocks, while the standard 8-4-50 Dry-Mix caused only slight injury with practically no leaf drop. The injury to the leaves was in the form of irregular spots, purple in color at first, later turning brown in the center with an irregular purple margin. The edges of many leaves also showed the same kind of injury. The twig injury occurred in the form of sunken cankers, purplish at first, later turning brown. They were very similar in appearance and size to brown rot cankers. A large percentage of the injured leaves dropped during July and the first part of August. The first injury and leaf drop occurred about July 1, although the last application containing lead arsenate was made on May 25. The cause of this injury has not been determined, but it is safe to assume from the appearance of the spots on the foliage and twigs that lead arsenate is directly or indirectly responsible for it. A thorough study of spray injury on peaches is now being made by Mr. Nico Mogendorff, a graduate assistant in the department of pomology.

Laboratory and greenhouse experiments conducted by Mr. Mogendorff substantiate the results obtained by previous investigators, indicating that the injury from lead arsenate must be due to soluble arsenic liberated during the slow decomposition of the lead arsenate on the leaves. Furthermore, it seems that sudden weather changes from cool and damp to warm are more likely to cause injury from lead arsenate than a continuous period of the same kind of weather. The chemical work carried on in connection with this study shows that when lead arsenate is combined with hydrated or freshly-slaked lime, it will be decomposed and converted into basic lead arsenate and insoluble tricalcium arsenate. The latter compound will be decomposed with the formation of soluble acid calcium arsenate by the action of carbon dioxide. It depends greatly on circumstances whether injury will be prevented, or a considerable burning and defoliation result from the above reactions. While some progress has been made

during the year, the problem is so involved that a very extensive and detailed study will be necessary before any definte results can be expected.

Dusting versus Spraying for Peaches

An experiment was conducted during the year to compare sulfur dust mixtures containing different percentages of sulfur and lime with Dry-Mix Sulfur Lime as summer fungicides for peaches. The following dust treatments were compared with Dry-Mix Sulfur Lime:

(1) 70-10-20 sulfur, lead arsenate, lime in the shuck fall and following application with an 80-20 sulfur-lime mixture in all subsequent applications.
(2) 60-10-30 sulfur, lead arsenate, lime in the shuck fall and following application with an 80-20 sulfur-lime mixture in all subsequent applications.

In addition to comparing the above dust mixtures with Dry-Mix Sulfur Lime in connection with the control of peach scab and brown rot, the experiment had as one of its objects a comparison of the cost of spraying and dusting peaches. The latter phase of the experiment is the only one in connection with which definite results were secured, since the failure of scab to develop on any of the dusted or sprayed blocks made it impossible to secure data on the relative effectiveness of the various mixtures.

Comparative Cost of Dusting and Spraying Peaches

The following figures were secured relative to the cost of spraying and dusting peaches in this particular orchard.

The trees were making their fourth summer's growth, but were large for their age, having an average spread of 16 to 18 feet, and a height of 8 to 10 feet. The sprayed block consisted of 8 rows with 105 trees in a row. This made a total of 840 trees, or, approximately, 8½ acres. The dusted blocks consisted of 5 rows of the same length, or slightly over 5 acres. The amount of dust used varied from 1/6 to ¼ pound per tree, and the amount of spray averaged 1¼ gallons per tree. All of the trees received a dormant application of concentrated lime-sulfur 1 to 9, the comparison between dusting and spraying starting with the shuck fall application in May. Both the sprayed and the dusted blocks received 4 applications, starting with the shuck fall.

It was found that one power duster operated by 2 men and a fast-walking team would handle 60 acres per day in this orchard. A power sprayer, on the other hand, operated by 3 men and a team would not handle over 15 acres per day in the same orchard. The spraying in this case was all done with rods and nozzles, not with spray guns. In view of the fact that 60 acres was an average day's work for a duster in this orchard, the comparison between dusting and spraying was based on 60 acres rather than upon the actual number of trees included in each plot. A charge of 30 cents per hour is made for all man and team labor.

COST OF SPRAYING 60 ACRES OR 6,000 FOUR-YEAR-OLD PEACH TREES

First application (shuck fall)

Man and team labor—		
40 hours for 3 men and team	$48.00	
Material—		
1875 pounds commercial Dry-Mix @ $0.05	93.75	
225 pounds powdered lead arsenate @ $0.20	45.00	
Total		$186.75

Second application

Same as first		$186.75

Third application

Man and team labor—		
Same as first application	$48.00	
Material—		
1875 pounds commercial Dry-Mix @ $0.05	93.75	
Total		$141.75

Fourth application

Same as third		$141.75
Total cost of four applications		$657.00
Difference in cost in favor of dust	$321.00	
Difference in cost per acre in favor of dust approximately	5.35	

COST OF DUSTING 60 ACRES OR 6,000 FOUR-YEAR-OLD PEACH TREES

First application (shuck fall)

Man and team labor—		
10 hours for 2 men and team	$9.00	
Material—		
1500 pounds 70-10-20 dust @ $0.06½	97.50	
Total		$106.50

Second application

Same as first		$106.50

Third application

Man and team labor—		
Same as first application	$9.00	
Material—		
1500 pounds 80-20 dust @ $0.03½	52.50	
Total		$61.50

Fourth application

Same as third		$61.50
Total cost of four applications		$336.00

The above figures do not include depreciation, interest on money invested, maintenance and operating expenses of the spraying and dusting equipment, all of which would increase the difference in favor of dusting.

The statement is often made that the cost of spraying and dusting is about equal, but in this particular orchard dusting was far more economical than spraying. In this connection the fact should be emphasized that a comparatively high-priced spray mixture was used and the application made with rods and nozzles instead of spray guns. The cost of spraying might have been considerably reduced by using a cheaper mixture such as Homemade Dry-Mix, which can be prepared for not over 2½ to 3 cents per pound. These figures indicate that in large commercial peach orchards dusting is more economical than spraying, both from the standpoint of time and actual cost of application. As far as insect and disease control is concerned we consider the dusting of peaches about as effective as spraying, with the exception of the dormant application for San José scale and leaf curl.

Spraying Experiments with Apples

Experiments were conducted in three apple orchards in the state to secure information on the comparative value of Dry-Mix Sulfur Lime and Concentrated Lime-Sulfur as summer fungicides. Comparisons were made in the orchards of Senator Emmor Roberts, Moorestown; Charles F. Repp, Glassboro; and Laton Parkhurst, Hammonton. In each orchard the scab infection was heavy in 1922. In the Roberts and Repp orchards there was less than one per cent scabby fruit in 1923 on unsprayed trees, and practically no scab at all on the sprayed trees regardless of the mixture used. Under these conditions it was impossible to secure any information on the fungicidal value of the various spray mixtures. In the Parkhurst orchard, however, scab infection was heavy, ranging from 45 per cent to 50 per cent affected fruit on unsprayed trees. Table 1 shows the data on scab control in this orchard.

All treatments included a dormant application of Concentrated Lime-Sulfur 1 to 9, and all summer treatments starting with the pink-bud application included powdered arsenate of lead 3 pounds to 100 gallons of mixture.

The figures in table 1 indicate that Dry-Mix Sulfur Lime is fully as effective as Concentrated Lime-Sulfur as a summer fungicide for apples, provided its use starts with the petal fall application. The figures also indicate that Concentrated Lime-Sulfur 1 to 40 is slightly more effective against scab than Dry-Mix, when both are applied at the pink bud stage. The fact that Concentrated Lime-Sulfur 1 to 40 is more effective than Dry-Mix when used for the pink bud application, combined with the fact that it seldom, if ever, burns the foliage, or causes russeting of the fruit at that time is sufficient basis for not recommending the use of Dry-Mix previous to the petal fall appli-

cation. The chief reason for substituting Dry-Mix for Concentrated Lime-Sulfur as a summer fungicide for apples is the fact that the latter often causes serious injury to the fruit and foliage when used at the petal fall application, or later. In many orchards where both

TABLE 1

Record of Scab Control on Apple. Laton Parkhurst, Hammonton, 1923

VARIETY	Treatment	Total fruits	Free from scab	Scabby fruits
			per cent	*per cent*
Delicious	1	590	87.3	12.7
Delicious	2	1479	85.5	14.5
Delicious	3	2124	78.4	21.5
Delicious	Check	273	22.0	78.0
Winesap	1	364	99.2	0.8
Winesap	2	1255	96.0	4.0
Winesap	3	247	100.0	....
Winesap	Check	404	43.4	56.6
Gano	1	294	95.4	4.6
Gano	2	813	95.8	4.2
Gano	3	343	96.3	3.7
Gano	Check	381	54.8	45.2
Jonathan	1	322	96.9	3.1
Jonathan	2	1270	97.1	2.9
Jonathan	3	1480	92.3	7.7

Treatment 1—Concentrated Lime-Sulfur 1 to 40 at pink bud followed by Concentrated Lime-Sulfur 1 to 50 during the balance of the season.
Treatment 2—Concentrated Lime-Sulfur 1 to 40 at pink bud, Dry-Mix Lime-Sulfur during the balance of season.
Treatment 3—Dry-Mix throughout the season starting with the pink-bud application.

Dry-Mix and Concentrated Lime-Sulfur were used throughout the season during the past summer, one mixture did not cause any more or any less injury than the other. This, however, was an unusual condition, not typical of the average season, and, therefore, should not be used as a guide for general spraying operations.

Some Factors That Influence the Effectiveness of Peach Thinning

There is comparatively little published data available relative to the thinning of peaches. Thinning of the fruit when the trees are heavily loaded is generally recommended, but not practiced as extensively as it should be by fruit growers in some peach-growing sections. It is generally recognized that thinning, properly executed, is a profitable and economical commercial practice. On the other hand, fruit growers frequently make the statement that thinning, as practiced in their orchards, does not produce the expected and desired results. Furthermore, requests are frequently made by fruit growers, extension workers, students and others interested directly or indirectly in the production or marketing of peaches for definite information based on experimental data relative to the proper time to thin, the amount of fruit to remove and the results to be expected with particular reference to actual increase in size of fruit, effect upon the number of baskets per tree or per acre, and the gain in net returns from the sale of the fruit.

Outline of Experiment

Numerous experiments have been conducted to secure information on these points, but all of those on which results have been published have been on a rather limited scale, and involved a small number of trees. In view of the conditions described, an attempt was made during the past season to secure some data based on the thinning of comparatively large numbers of trees. An experiment was outlined and carried through the season involving two varieties, namely, Carman and Bell of Georgia, approximately 300 trees of each variety and over 1,800 bushels of fruit. The experiment was conducted in the Seabrook Orchards, at Bridgeton, in Cumberland County, New Jersey. Young, vigorous trees making their fourth summer's growth, with an average spread of 16 feet, were used in the thinning treatments. In addition to a check 6 thinning treatments were carried through on each variety. Each treatment involved from 45 to 50 trees of a variety, while 16 Carman and 15 Belle trees were left unthinned as a check. The chief factors studied in this experiment were two—first, the effect of degree of thinning, and second, the effect of time of thinning.

The thinning treatments on each variety may be designated as follows: 1. Early—light; 2. Medium—Light; 3. Late—Light; 4. Early—Heavy; 5. Medium—Heavy; 6. Late—Heavy.

Time and Degree of Thinning

The early thinning was on June 7 and 8, while the pits were still soft and watery. The medium thinning was just two weeks later, on June 21 and 22, at which time the pits were hard and the kernels still soft. The late thinning was on July 5, when the average transverse

diameter of Carman was 1.32 in. and of Belle 1.37 in. The light thinning consisted of removing the green fruits so that those left on the tree were spaced from 4 to 6 in. along the branches, while after the heavy thinning the fruits were spaced 6 to 8 in.

Amount of Fruit Set and Number Removed

The average number of fruits removed from each Carman tree by the 4 to 6-in. thinning was 787, or 36.56 per cent, while the average number of fruits removed by the 6 to 8-in. thinning was 1,012, or 52.64 per cent. The average number of fruits removed from each Belle tree by the 4 to 6-in. thinning was 505, or 40.89 per cent, and the average number of fruits removed by the 6 to 8-in. thinning was 796, or 55.54 per cent. The average number of fruits that set on the Carman trees was 1,921, and on the Belle 1,330, a difference of 591, or, approximately, 600 fruits.

The average size of the fruit on each thinning date, and at 2-week intervals until it was picked, was determined in terms of greatest transverse diameter. The average size of Carman on June 7, the first thinning date, was 1.18 in., and the average size of Belle at the same time was 1.23 in., a difference of .05 in. Table 2 shows the average gain in size of fruit during 2-week intervals, from the date of the first thinning until the fruit was picked, as well as the average size of the fruit on the date of the first picking.

The figures in table 2 agree with the observations frequently made by investigators and fruit growers relative to the slow growth of the peach during the period when the pits are hardening. During the past season in this particular orchard the pits began to harden between June 15 and 20, being quite hard on June 22, the date of the second or medium-early thinning. It will be noted that the fruit of both varieties grew very slowly during the 2-week period, beginning June 22. In this connection, it is of interest to note that the Belle of Georgia fruits also grew slowly during the 2-week period, beginning July 6; the total gain from June 22 to July 19 being less than the gain from July 19 to August 3, the former a 4-week period and the latter a 2-week period. Although the development and hardening of the pits has a direct effect upon the growth of the fruit, its relation to the time of thinning is not so apparent. While it is true that early thinning of a certain degree resulted in larger fruit than late thinning of the same degree, it is also true that late, heavy thinning increased size more than early, light thinning. In other words, these figures indicate that degree of thinning, or the percentage of fruit removed, is fully as important as the time of thinning, particularly in so far as the time relates to the period during which the pits are hardening. Therefore, while it is undoubtedly desirable to recommend early thinning, the time should not necessarily be determined by the condition of the pits, since, with the mid-season varieties, at least, there is apparently a moderately long time during which peaches

may be thinned with equally effective results. Furthermore, all recommendations should be accompanied by rather specific directions regarding the degree of thinning, or, in other words, the amount or percentage of fruit to be removed.

Difference in Set of Fruit

It has already been noted that the set of Belle on the trees included in this experiment was considerably lighter than the set of Carman. In this connection it is of interest to note that the trees of both

TABLE 2

Average Gain in Size of Fruit in Terms of Greatest Transverse Diameter

BELLE OF GEORGIA

TREATMENT	June 8 to June 22	June 22 to July 6	July 6 to July 19	July 19 to Aug. 3	Aug. 3 to Aug. 17	Total for 10 wks.	Average Size Aug. 17
4 to 6″ June 8...	.12	.06	.07	.19	.51	.95	2.19
4 to 6″ June 22..	.11	.05	.07	.16	.49	.88	2.11
4 to 6″ July 5....	.11	.03	.08	.16	.52	.90	2.13
6 to 8″ June 8...	.21	.07	.04	.23	.48	1.03	2.26
6 to 8″ June 22..	.11	.08	.09	.21	.43	.92	2.15
6 to 8″ July 5....	.11	.03	.14	.20	.52	1.00	2.23
Check	.11	.03	.06	.15	.31	.66	1.89

CARMAN

					Total for 8 weeks	Average Size Aug. 3
4 to 6″ June 7...	.15	.06	.18	.36	.75	1.93
4 to 6″ June 21..	.11	.06	.16	.40	.73	1.91
4 to 6″ July 5....	.11	.03	.18	.34	.66	1.84
6 to 8″ June 7...	.23	.09	.18	.44	.94	2.13
6 to 8″ June 21..	.11	.10	.19	.43	.83	2.01
6 to 8″ July 5....	.11	.03	.26	.40	.80	1.98
Check	.11	.03	.18	.22	.54	1.72

varieies were of the same age and practically of the same size, thereby making each capable of maturing the same number of fruits. As a matter of fact, however, in this experiment the average unthinned Carman tree matured 1,870 fruits, while the average unthinned Belle tree matured only 1,264 fruits, a difference of 606 fruits per tree. This difference in set was not due to any appreciable difference in

number of fruit buds or amount of bloom, but was the result of a heavier June drop from the Belle trees. The effect of this drop on the amount of fruit removed on the various thinning dates is shown in table 3. That is, the amount of fruit removed by thinning on the various dates decreased as the season advanced, because of the continuous drop of Belle fruits during June. The effect of this drop is also seen in the total yield, the difference being particularly great between the early and medium-early thinnings of the same degree.

TABLE 3

Effect of Thinning Treatments on Size of Fruit and Yield Per Acre

CARMAN

TREATMENT	Average total set per tree	Average fruits per tree removed by thinning	Average fruits per tree harvested	No. bushels per acre of different grades: 1⅞ or less	1⅞ to 2⅛	2⅛ to 2⅜	2⅜ and up	Total bushels per acre
4 to 6″ June 7.....	1821	584	1236	23	164	135	26	348
4 to 6″ June 21....	2078	891	1152	31	197	117	7	352
4 to 6″ July 5......	1907	748	1164	29	179	104	9	321
6 to 8″ June 7.....	1741	937	803	8	97	181	35	321
6 to 8″ June 21....	2041	1063	977	9	173	158	13	353
6 to 8″ July 5......	1896	984	912	19	175	109	6	309
Check	1870	....	1870	217	259	18	...	494

BELLE OF GEORGIA

TREATMENT	Average total set per tree	Average fruits per tree removed by thinning	Average fruits per tree harvested	1¾ or less	1¾ to 2¼	2¼ to 2¾	2¾ and up	Total bushels per acre
4 to 6″ June 8.....	1427	659	768	2	16	77	141	236
4 to 6″ June 22....	1320	491	829	2	40	185	120	347
4 to 6″ July 5......	991	367	624	2	34	131	88	255
6 to 8″ June 8.....	1476	913	563	1	10	50	115	176
6 to 8″ June 22....	1502	771	731	3	58	137	79	277
6 to 8″ July 5......	1334	714	620	2	26	128	98	254
Check	1264	....	1264	68	228	127	12	435

Under such conditions, early thinning may be very undesirable, because of the danger of reducing yield to a point that will entirely eliminate any advantage gained in size of fruit. Table 3 also shows that the average total set of fruit was very uniform on both varieties,

this being particularly true of Carman, where the greatest variation was less than 250 fruits. This condition indicates exceptional uniformity in pruning, fertilization and other cultural practices.

Method of Recording Average Set per Tree

At least five typical trees of each variety in each thinning treatment were selected as count trees. The actual number of fruits removed by thinning, and the number of fruits harvested from each count tree was recorded and the resulting figures used to compute the average number of fruits per tree removed by thinning, the average number of fruits per tree harvested and the average total set per tree.

Method of Recording Relative Size and Yield

The total amount of fruit harvested from the trees in each thinning treatment was recorded at each picking and each lot graded separately into four sizes by running the fruit over a Burke grader. The effect of the thinning treatments on the size of the fruit and the comparative yield per acre is shown in table 3.

It should be stated in this connection that the average size of all fruit, particularly Carman, was below normal, because of the extremely dry weather that prevailed during a large part of the growing season.

One of the most striking features in connection with the data on Carman is the uniformity of yield between the various thinning treatments. The average yield per tree following the 6 to 8-in. thinning treatments was only four quarts less than the average yield per tree following the 4 to 6-in. thinning, while the average yield from all the thinned trees was slightly over a bushel less than the average yield of the unthinned. There is considerably more variation in yield between the thinning treatments on Belle; the heavy thinning, particularly the early-heavy thinning, reducing the yield to a rather marked degree. This was undoubtedly due, at least, partly to the drop that followed the first thinning, and continued to some extent for several weeks, thus resulting in a smaller number of fruits at maturity than would normally follow a 6 to 8-in. thinning. There are several points in connection with the dates on Belle that cannot be explained, such as the high yield on the 4 to 6-in thinnning June 22, and the light set on the trees thinned 4 to 6-in. July 5. The most plausible explanation for the high yield in the first case mentioned is that some of the trees in this particular row were somewhat above the average in size and vigor, while in the row showing a light set the opposite condition existed.

Heavy Thinning Reduces Amount of Small Fruit

The figures in table 3 agree with the general observation that heavy thinning decreases the amount of small fruit, and increases the

amount of large fruit. Furthermore, early thinning increased the size to a greater extent than later thinning of the same degree. The unthinned trees show a high number of small fruits, although, in the case of Belle, this is offset to a large degree by the increased yield, and the large amount of fruit of medium size.

The average cost of thinning in this orchard varied from $8.00 to $10.00 per acre. This cost is based upon the average man at $3.00 per day thinning from 3 to 4 trees per hour.

With Carman early, heavy thinning gave the highest return followed by medium-heavy, light-early and light-medium. Late thinning, on the other hand, gave relatively low returns regardless of the degree of thinning. Furthermore, the returns from the unthinned trees compare favorably with the returns from some of the thinning treatments, particularly with Belle, where the value of the fruit from the check is actually higher than from the early-heavy thinning, because of the great difference in yield.

TABLE 4

Effect of Thinning Treatments on Returns per Acre

TREATMENT	Carman	Belle
4 to 6″ June 7 and 8	$172.00	$351.50
4 to 6″ June 21 and 22	171.00	461.75
4 to 6″ July 5	138.40	335.25
6 to 8″ June 7 and 8	191.60	269.00
6 to 8″ June 21 and 22	176.40	339.25
6 to 8″ July 5	136.70	345.00
Check	112.00	309.75

Above Amounts Based on Following Price Per Bushel at Packing House

VARIETY	Grades			
	1	2	3	4
Carman	$0.10	$0.30	$0.70	$1.00
Belle	.25	.50	1.25	1.75

Summary

1—Two degrees of thinning—namely, 4 to 6 inches and 6 to 8 inches, both increased the size of the fruit over unthinned trees.

2—The degree of thinning or percentage of fruits removed was fully as important as the time of thinning.

3—The statement commonly made to the effect that to secure satisfactory results peaches should be thinned before the pits harden was not substantiated in this experiment.
4—Early thinning was particularly effective with Carman, a comparatively early-ripening variety.
5—There is evidently a relatively long period during which each variety, particularly those ripening with Belle or later, may be thinned with equal effectiveness.
6—Heavy thinning increased the number of large fruits without materially decreasing the yield, with one exception in the case of Belle, where early-heavy thinning combined with an abnormal drop made a decided reduction in yield.
7—This experiment shows a direct relation between degree of thinning and size of fruit.
8—The degree of thinning may be carried to such an extreme that the advantage gained in size of fruit will be lost by a decrease in yield.
9—The results of this experiment indicate the importance of considering varietal and individual orchard conditions in making thinning recommendations.
10—The thinning of peaches, although a simple operation in itself, involves many details and factors that deserve careful consideration by fruit growers as well as investigators.

Small-Fruit Projects

The small-fruit work conducted during the year consisted of a continuation of the black-cap raspberry spraying experiment for the control of anthracnose in cooperation with the department of plant pathology, cultural studies of strawberries, variety tests of strawberries, blackberries and raspberries and pruning experiments with red raspberries. This work has been under the direct supervision of Mr. T. C. Rogers, who submits the following report on new varieties of strawberries:

Strawberry Varieties

The spring of 1924 was moderately favorable for strawberries. Although a great deal of rain fell during blossoming time, there was a heavy set of fruit on practically all varieties. Frequent rains during the ripening period caused considerable soft fruit with some rot. This was particularly noticeable on such varieties as Howard's 17, which has short, slender fruit stems, thus allowing a large portion of the fruit to touch the ground before it reaches maturity. The following varieties were fruited during the year and compared with such standard varieties as Joe, Lupton, Chesapeake and Howard's 17.

Aberdeen—Perfect—Plants medium in size, vigorous, low growing, good plant maker. Foliage medium size, light green. Heavy yielder.
Berry—Medium large, conical, regular, unattractive, light red, seeds even and regular. White core, fairly soft. Mid-season to late, fair quality.

Barrymore—Perfect—Plants medium in size, number and vigor. Healthy, light green foliage. Production fair.
Berry—Medium size, round conical, attractive, deep red. Flesh light red throughout, firm, excellent flavor. Mid-season.

Eaton—Perfect—Plants numerous, fairly vigorous, considerable leaf spot, leaves medium size, light green. Poor yielder.
Berry—Medium large, conical, with a slight neck. Seeds very deep and sunken, berry soft, dark red. Flesh deep red throughout, flavor slightly acid. Mid-season.

Howard's 25—Perfect—Plant medium in size and vigor, leaves showed considerable leaf spot. Very productive.
Berry—Medium to large. Not so long, but wider than Howard's 17. Dark brick red, with deep red-colored flesh. Medium soft, but slightly firmer than Howard's 17. Seeds slightly sunken. Very high flavor. Season few days later than Howard's 17.

Hunterdon—Imperfect—Plant medium in vigor and size, healthy. Leaves medium size and dark green, fairly short stem, fruit stem fairly upright. Foliage inclined to rust and spot during a dry season.
Berry—Medium late. Fruit conical, good size, calyx small and very persistent. Seeds sunken and irregular, medium, firm. Only fair yielder, flesh pinkish with white core.

Sweet Belle—Perfect—Plant numerous, large, vigorous, healthy. Leaves very large, medium green with long stems. Poor yielder.
Berry—Mid-season, very small, round with a very pronounced neck, soft, light red. Seeds fairly prominent, fairly firm, tart.
Of little value either for commercial or home use.

Virginia—Perfect—Plants medium size, vigorous, healthy. Leaves dark green, medium size, stems long. Fair yielder.
Berry—Late, large, about same shape as Lupton, quite rough. Seeds sunken. Light, attractive red, flesh red throughout, soft, acid.

Wyona—Perfect—Plants numerous and vigorous, healthy foliage, one of the most free from leaf spot on the Farm. Medium green, very good yield.
Berry—Late, large, same shape as Lupton and Virginia. Not quite so rough as Virginia. Seeds sunken, light red in color. Flesh pink, white center, soft, acid, poor quality.

Among the new varieties of strawberries fruited during the year that appear promising enough to warrant further consideration are Aberdeen, Howard's 25, and Wyona. Aberdeen and Wyona have possibilities as late-ripening varieties, while Howard's 25 appears to be promising as a mid-season variety of high quality for local market trade. Aberdeen appears to be a variety that will do better on moderately light soils than on heavy soils, because of its tendency to develop strong, rank foliage.

Propagation and Distribution of Peach Seedlings

Three thousand six hundred and twelve one-year budded trees of 28 promising peach seedlings were distributed among 121 fruit growers of the state during the spring of 1924. One of these seedlings distributed in 1922 and 1923, under the introduction number 22-BG, was considered worthy of a name and christened Pioneer. A description of Pioneer, which is a Belle x Greensboro cross, ripening a few days before Carman, is given in the 1922 report. During the summer of 1923, 10,250 buds of Pioneer were distributed among 10 nurserymen and peach growers of the state.

In addition to Pioneer the following trees were distributed under introduction numbers:

17—1-B	128—32-EB	146—39-BG	6—46-B
53—25-BG	16—33-EB	50—40-CS	17—47-BG
292—26-BG	324—34-E	25—41-SD	33—48-B
17—27-BG	11—35-E	14—42-B	16—51-SA
25—28-BE	3—36-E	53—43-ECE	12—52-SD
3—30-ECE	39—37-BG	17—44-EB	4—54-SA
8—31-ECE	*292—38-EG	7—45-E-EC	1—56-SD

*Trees propagated by Howard F. DeCou, Merchantville, from buds furnished by the Experiment Station in August, 1922. All of the trees of this seedling were planted by Mr. DeCou in April, 1924, none being distributed among other growers.

Experiments with Grapes

Two new lines of work in connection with grape culture were started during the spring of 1924 under the direct supervision of Mr. J. H. Clark. One involves the relationship between pruning and fruit production, and the other a fertilizer experiment. The chief objects of the pruning experiments are as follows:

1—A study of fruitfulness as affected by the age of wood from which the cane develops.
2—A study of the length of cane and length of internode as affecting fruitfulness of canes and individual buds.
3—A study of the effect of the number of buds and canes left at pruning time on immediate and subsequent yields.
4—To determine the method of pruning best adapted to bring young vines just planted into early and profitable bearing.

The fertilizer experiment is a study of the effects on growth and fruit production of muriate of potash, acid phosphate and varying amounts of nitrate of soda. Acid phosphate at the rate of 400 pounds per acre and muriate of potash at the rate of 150 pounds per acre are applied alone, and in combination with 100, 200 and 300 pounds of nitrate of soda per acre. The experiment is being conducted on the farm of C. Manzelli, near Minatola, N. J., in a block of Ives that has not been fertilized for several years. The soil is a very light, sandy loam, and should respond quite readily to fertilizer treatments, particularly those containing nitrogen.

Fruit Crop Conditions

Lack of rainfall during the spring and summer of 1923 resulted in a large amount of small fruit, in some cases the production, as well as the size, being considerably below normal. Strawberries were almost a total failure in many sections of the state, because of the severe drought, while the raspberry and blackberry crops were materially reduced. Peaches and apples, particularly early varieties, such as Yellow Transparent, Red Astrachan, Carman and Lola, were far below their normal size, while the later varieties were affected to a considerable extent. Fruit in general, although below normal in

size, was exceptionally free from fungous diseases. Furthermore, a comparatively cool, dry fall developed good color on most varieties of winter apples. The season, as a whole, was unfavorable, since prices were generally low, except on fruit of large size. The spring of 1924 opened with a heavy bloom on all kinds of fruit, with prospects for a big crop. However, almost continuous rain, combined with low temperatures during the blooming season made conditions for pollination unfavorable, and resulted in a light set of apples in many orchards. Peaches, apparently, set heavy in most orchards, but a late drop during the latter part of June reduced the set to a normal, or below normal, crop in some sections. Abnormal rainfall during April, May and June, with temperatures somewhat below normal during a large part of the same period, delayed fruit development so that the season was at least a week or ten days later than normal by July 1, in spite of the fact that conditions were practically normal at the beginning of the blossoming period.

Blooming Dates of Apples and Peaches

The blooming dates of apples and peaches were recorded at New Brunswick, and also by the following commercial fruit growers: Richard E. Wais, Lebanon; Robert P. Hulsart, Manasquan; W. W. Oley, Bridgeton; Locust Grove Farm, Westville; Lemuel Black, Hightstown; Howard F. DeCou, Haddonfield; Julian F. Miller, Glassboro, and Bertrand Gillette, Vineland.

Tables 5 and 6 give the dates of first bloom and full bloom as reported by each grower, together with the dates on which each grower applied the delayed dormant pink-bud and petal-fall spray on apples and the dormant petal-fall and shuck-fall spray on peaches. A comparison of the blooming dates of apples during 1923 and 1924 indicates that the first bloom occurred from 4 to 10 days later in 1924. Furthermore, it will be noted, in comparing the blooming period of apples at New Brunswick with the rainfall record, that rain fell on 7 of the 8 days between first bloom and full bloom. Considerable rain also fell between full bloom and petal fall. The blooming period of peaches was about the same in 1923 and 1924, while the weather conditions in 1924 were very favorable for pollination during the peach-blooming season. The effect of the cold, wet weather early in May is also shown by the great difference in date of first bloom between New Brunswick and Lebanon, being 8 days in 1924 and only 2 days in 1923.

TABLE 5

Blooming Dates of Apples in Various Sections of New Jersey, 1924

VARIETY	Lebanon Hunterdon Co.		New Brunswick Middlesex Co.		Hightstown Mercer Co.		Manasquan Monmouth Co.		Haddonfield Camden Co.		Westville Gloucester Co.		Glassboro Gloucester Co.		Bridgeton Cumberland Co.	
	First Bloom	Full Bloom	First Bloom	Full Bloom	First Bloom	Full Bloom	First Bloom	Full Bloom	First Bloom	Full Bloom	First Bloom	Full Bloom	First Bloom	Full Bloom	First Bloom	Full Bloom
Baldwin	5/14	5/18	5/6	5/16	5/5	5/10	5/13	5/16	......	......	5/2	5/6	......	......	......	......
Banana	......	......	5/7	5/15	......	......	......	......	......	......	......	......	......	......	......	......
Ben Davis	......	......	5/7	5/15	5/5	5/10	5/11	5/17	......	......	5/2	5/7	......	......	......	5/7
Delicious	5/15	5/19	5/7	5/15	5/5	5/10	5/11	5/17	5/3	5/7	5/3	5/6	......	......	......	5/7
Duchess	5/13	5/17	5/4	5/8	5/4	5/8	5/5	5/8	......	......	4/29	5/4	......	......	5/2	5/6
Gravenstein	5/12	5/16	5/4	5/8	5/6	5/11	......	......	5/1	5/3	4/29	5/4	......	......	5/1	5/5
Grimes	5/15	5/18	5/6	5/15	5/8	5/14	5/8	5/16	5/6	5/9	5/4	5/7	......	......	......	5/5
Jonathan	5/15	5/19	5/7	5/15	5/8	5/14	5/11	5/17	......	......	5/4	5/7	......	......	......	......
King	......	......	5/5	5/12	......	......	......	......	......	......	......	......	......	......	......	......
King David	......	......	5/7	5/15	......	......	......	......	......	......	......	......	......	......	......	......
McIntosh	5/14	5/18	5/7	5/12	5/8	5/14	5/6	5/12	......	......	5/4	5/6	......	......	......	......
Paragon	5/15	5 19	5/7	5/15	5/8	5/14	5/8	5/15	5/6	5/9	5/3	5/5	5/5	5/9	5/4	5/8
Red Astrachan,	5/14	5/18	5/4	5/8	5/1	5/4	5/5	5/12	......	......	5/1	5/5	......	......	......	......
Rome	......	......	5/9	5/17	......	......	......	......	......	......	......	......	......	......	......	......
R. I. Greening,	5/14	5/18	5/7	5/15	5/7	5/15	5/11	5/16	......	......	......	......	......	......	......	......
Starr	......	......	......	......	5/6	5/10	......	......	5/2	5/5	......	......	......	......	......	......
Stayman	5/13	5/17	5/6	5/15	5/7	5/14	5/8	5/16	5/6	5/9	5/3	5/7	5/5	5/9	5/3	5/7
Stark	5/16	5/19	5/6	5/15	......	......	......	......	......	......	5/3	5/6	......	......	......	......
Transparent	......	......	5/6	5/12	5/8	5/12	5/11	5/15	......	......	5/4	5/7	......	......	5/4	5/7
Wealthy	5/15	5/19	5/6	5/16	5/8	5/14	5/9	5/16	5/2	5/5	5/1	5/7	......	......	5/4	5/8
Winesap	5/16	5/19	......	......	5/8	5/16	5/11	5/16	......	......	5/4	5/10	5/6	5/12	5/4	5/8
Williams	......	......	5/12	5/19	5/10	5/16	5/9	5/17	5/6	5/10	......	......	......	......	5/5	5/8
Wilson Red June	......	......	5/7	5/15	......	......	......	......	......	......	......	......	......	......	......	......

York Imperial,	5/17	5/20	....	....	5/10	5/17	5/13	5/18	5/7	5/13	5/5	5/10	5/6	5/15	5/4	5/7
Approximate date for majority of varieties	5/15	5/19	5/7	5/15	5/8	5/14	5/11	5/16	5/6	5/9	5/4	5/7	....	....	5/4	5/7
Delayed dormant spray..	4/21		4/12 to 4/15		4/11 to 4/16		4/11 and 4/12		4/14 to 4/21		4/9 to 4/14		4/6 to 4/12		4/5 to 4/12	
Pink bud spray,	5/6		5/6		5/1 to 5/3		5/5 and 5/6		5/2 to 5/6		4/28 to 5/1		4/28 to 5/3		4/28 to 5/3	
Petal fall spray	5/22 to 5/26		5/20		5/17 to 5/24		5/19 and 5/23		5/16 to 5/23		5/16 to 5/20		5/17 to 4/24		5/13 to 5/19	

First Bloom	Full Bloom	First Bloom	Full Bloom	First Bloom	Full Bloom
4/25	5/2	....	....	4/22	4/26
4/22	4/27	4/24	4/28	....	....
4/22	4/29	4/24	4/28	4/23	4/27
4/21	4/27	4/24	4/28	4/22	4/26
4/24	4/29	4/24	4/28	....	....
4/25	4/29	4/24	4/28	4/24	4/28
4/25	4/30	4/24	4/28	4/22	4/26
4/20	4/28	4/24	4/28	4/21	4/25
4/27	5/2	4/26	5/1	....	....
4/25	5/2	4/26	5/1	4/22	4/26
4/25	4/29	4/24	4/28	4/22	4/26
3/27 to 3/29 5/1 to 5/5 5/26 to 5/29		3/29 .... 5/24		4/10 to 4/12 .... 5/26 to 5/27	

Blooming Dates of Grapes, 1924

Horticultural Farm

NEW BRUNSWICK

Varieties	First Bloom	Full Bloom	Varieties	First Bloom	Full Bloom
Berckmans	June 16	June 22	Duchess	June 20	June 26
Agawam	June 18	June 22	Eumelan	June 20	June 24
Campbell Early..	June 18	June 23	Niagara	June 20	June 23
Moore Early ...	June 18	June 22	Ontario	June 20	June 24
Portland	June 18	June 22	Wilder	June 20	June 23
Vergennes	June 18	June 23	Brilliant	June 21	June 25
Catawaba	June 19	June 22	Brocton	June 21	June 27
Ellen Scott	June 19	July 2	Diamond	June 21	June 24
Ives	June 19	June 23	Eclipse	June 21	June 25
Salem	June 19	June 22	Empire State ...	June 21	June 25
Wapanuka	June 19	June 22	Iona	June 22	June 26
Winchell	June 19	June 24	New York 93-A..	June 22	June 26
Brighton	June 20	June 24	New York 4066..	June 24	June 27
Caco	June 20	June 25	Westfield	June 25	July 2
Concord	June 20	June 24	Lignan Blanc ..	June 26	July 2
Delaware	June 20	June 24	Rose Royal	June 27	July 2

Report of Weather Observations

CLARENCE H. STEELMAN

Weather conditions during the year ending June 30, 1924, were very abnormal in several respects. July and August were very dry, the total rainfall for July being 3.93 inches, which is 2.49 inches below normal, and the month of August was still worse with only 1.29 inches of rain or 3.46 inches below normal. These 2 dry months, preceded by a dry April, May and June, had a noticeable effect on all kinds of vegetation, including fruit. Although normal rainfall for the above 5 months is 22.67 inches, the actual rainfall during that period in 1923 was 10.23 inches, or a deficiency of 12.44 inches.

Following a very hot, dry summer, and a moderately cool, late fall, came a mild winter with very little snow. The month of December, was the warmest on record since 1896. The monthly mean was 41.8°, which is 9.8° above normal. The nearest to this record was in 1918, with a mean temperature of 38.7° for December. The heaviest snowfall of the winter was 6.25 inches, which occurred on April 1, and was accompanied by a thunder shower.

The spring of 1924 was exceptional, because of the cold, wet weather during April, May and the early part of June. There were 11 stormy days during April, and a total precipitation of 5.92 inches, or 2.47 inches above normal. This was followed by 19 rainy days in May, with a total rainfall of 6.08 inches or 2.36 inches above normal. The above amount of rainfall in May has been exceeded only once, which was in May, 1898, when there were 22 rainy days, and a total rainfall of 7.86 inches. The excessive rainfall during May was accompanied by a mean temperature of 56.6°, which is 5.8° below normal. The combination of rain and low temperature resulted in delaying fruit development to such an extent that, by June 1, it was at least 10 days or 2 weeks later than normal.

In view of the abnormal weather conditions just described, it is of interest to note that the total rainfall for the year, 46.12 inches, compared with a normal of 47.44 inches, and a mean temperature of 51.65° compared with a normal of 51.7°, were both very close to normal.

The greatest precipitation in 24 hours occurred when between the hours of 5 P. M. on February 19 and 11 A. M. on February 20, 2.35 inches of rain fell.

The first killing frost occurred on November 1, and the last killing frost was on April 4.

TABLE 7

Mean Temperature for 1923-1924 Compared with Normal

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
Mean temperature 1923-24	71.2	71.0	67.6	53.9	43.3	41.8	32.2	27.9	38.8	49	56.6	66.5
Normal mean temperature	74.9	72.4	66.3	55.4	43.6	32	29.7	27.8	38.2	49.7	62.4	68.8

TABLE 8

Monthly Maximum and Minimum Means of Temperature for the Year Ending June 30, 1924

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
Maximum	83.7	83.1	78.7	64.9	52.7	49.9	42.1	35.5	48	59.3	66.2	76.3
Minimum	58.7	58.9	56.5	43.0	33.9	33.7	22.4	20.4	26.6	38.8	47.1	56.6

TABLE 9

Daily and Monthly Precipitation at the College Farm for the Year Ending June 30, 1924

Date	July 1923	Aug. 1923	Sept. 1923	Oct. 1923	Nov. 1923	Dec. 1923	Jan. 1924	Feb. 1924	Mar. 1924	Apr. 1924	May 1924	June 1924
	in.	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*
1,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.38	.40	.....
2,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.18	.....	.10
3,	.26	.....	.....	.....	.....	.....	1.37	.....	.....	.....	.13	.....
4,	.81	.....	T	.....	.....	.....	.....	.....	.....	.....	.....	.....
5,	.40	.01	.....	.....	.....	1.10	.....	1.18	.02	.....	.....	.....
6,	.15	.....	.23	.....	.17	.20	T	.13	.12	.72	.....	.01
7,	.....	.....	.....	.....	.17	.....	.....	.....	.....	1.94	.04	.20
8,	.....	.....	.43	.....	.....	.....	.....	T	.....	.....	.17	.16
9,	.....	.....	.04	.....	.....	.....	.....	.....	.....	T	1.45	.07
10,	.....	.....	T	.....	.....	.05	.....	.10	.....	.01	.03	.....
11,	.37	.....	.....	.....	.....	.11	1.22	.....	.99	.....	.16	.....
12,	.09	.22	.....	.....	.....	.....	.....	.11	.24	.....	1.25	.25
13,	.....	.28	.08	.....	.....	.....	.....	T	.....	.....	.....	.17
14,	.....	.....	.....	.....	.....	.22	.....	T	.....	.....	.....	.44
15,	.....	.14	.....	.11	.....	.....	.....	T	.....	.....	.03	.....
16,	.45	.....	.....	.....	.....	.....	.48	.....	.....	.....	.....	.....
17,	.....	.....	.....	.....	.02	.....	.75	T	.....	T	.01	.....
18,	.....	.....	.....	.....	.....	.....	.....	.14	.....	1.48	.....	.....
19,	.....	T	.07	.37	.....	.....	.....	.07	.....	.36	.23	.....
20,	.....	.....	.....	.23	.....	.....	.....	2.35	.....	.17	T	.15
21,	.....	.....	2.05	.....	.....	.....	.....	.....	.....	.....	.25	T
22,	.13	.31	.60	.....	.01	.43	.....	.....	.....	.29	.04	.....
23,	.23	.....	.37	.80	.45	.78	.....	.....	.....	.....	.....	.....
24,	.....	.....	.....	2.04	.38	.04	.....	.....	.....	.....	.63	.....
25,	.31	.....	.....	.....	.....	.....	1.21	.....	.....	.....	.79	.48
26,	.....	T	.....	.....	.....	.....	.....	.04	.49	.....	.....	.....
27,	.....	.....	.....	.....	.03	.....	.....	.....	.02	.....	.07	.58
28,	.28	.....	.....	.....	.....	.52	.....	.....	.03	.....	.13	.02
29,	.41	.33	.....	.09	.....	.....	.....	.....	.04	.31	.23	.41
30,	T	T	.....	.....	.89	.10	.....	.....	.34	.08	.04	.15
31,	.04	.....	.....	.58	.....	.51	.....	.....	.....	.....	.....	.....
Total	3.93	1.29	3.87	4.22	2.12	4.06	5.03	4.12	2.29	5.92	6.08	3.19
Normal	6.42	5.75	3.97	4.11	3.30	3.74	3.28	3.61	4.08	3.45	3.72	3.33

Peach Breeding Technical Phase—Project 4

C. H. Connors

During the winter of 1923-24 the older peach seedlings were largely eliminated, only about 20 of the original trees now remaining.

Additional plantings were made in the spring of 1923 of seedlings resulting from the breeding work of 1922. The seedlings planted were as follows:

Elberta self-pollinated, 7; Elberta x 32 E-B, 4; Elberta x Elberta and Iron Mountain, 9; Elberta x 49815, 3; Heath x Elberta, 2; Heath x Krummel, 11; Heath x 34 E, 1; Foster x 29 EC-E, 2; St. John x 49815, 1; St. John x 35416, 1; 38815 open-pollinated, 4; 38915 open-pollinated, 1; 43215 open-pollinated, 1; J. H. Hale open-pollinated, 135; 35416 open-pollinated, 20; 1 B open-pollinated, 43; 6214 open-pollinated, 20; Elberta nectarine open-pollinated, 18.

Favorable weather conditions during the blooming season of 1923 allowed a good set of fruit, and, as a result of the breeding for that year, 1,222 seedlings are now growing in the nursery. These are mainly crosses of promising station seedlings upon Elberta and J. H. Hale, as follows:

J. H. Hale x 38 E-G, 118, J. H. Hale x 29 EC-E, 36; J. H. Hale x 55115, 15; J. H. Hale x 40 C-S, 192; J. H. Hale x 27116, 138; J. H. Hale x 53 L-A. 184; Elberta x 53 L-A. 51; Elberta x 38 E-G, 60; Elberta x 38915, 50; Elberta x 39015, 38; Elberta x 49815, 28; Elberta x double white-flowered peach, 49; Elberta x Late Champion, 82; Elberta x purple-leaved peach, 7; Elberta x Elberta and Albino, 32; Fitzgerald x 25 B-G, 5; Fitzgerald x 38 E-G, 14; Fitzgerald x 29 EC-E, 5; Fitzgerald x 40 C-S, 1; Fitzgerald x 55115, 18; Fitzgerald x 38915, 4; Double white-flowered peach, 15; double red-flowered peach, 4; double pink-flowered peach, 1; Chinese Cling open-pollinated, 23; Sargent's Chinese peach, 16; and drops from crossed trees, 36; total, 1,222.

One very interesting fact is that all of the 7 seedlings resulting from Elberta x purple-leaved peach have purple leaves.

Breeding Work for 1924

Conditions during the blooming season of 1924 were very favorable, and about 15,000 emasculations and 15,000 pollinations were performed on the 13 trees which were covered. However, growing conditions have been such that great quantities of peaches have dropped. In spite of this, 2,000 to 3,000 seeds should be harvested. These follow three lines of breeding—(1) to improve or supplant the early varieties by crossing J. H. Hale and Elberta with early ripening yellow-fleshed seedlings of high quality but poor shipping quality; (2) to improve or supplant the late varieties by crossing Krummel's October with some late-ripening seedlings and commercial varieties; (3) to study the genetic characters of dwarfness, leaf and blossom color by crossing and selfing appropriate varieties.

Descriptions of Peach Seedlings

As peach seedlings are planted in the orchards, each one is given a serial number for purposes of identification. When a seedling appears to be of sufficient merit to warrant its dissemination on a limited or extended scale, it is given a new number which signifies its place in the series of disseminated seedlings and indicates its origin.

The first 24 members of the series were described in the annual report for 1922. Descriptions of the remaining numbers follow:

25 BG Belle x Greensboro—large blossom, semi-free, oval, large, bright and attractive, white, good, few days before Carman.

26 BG Belle x Greensboro—large blossom, semi-free, oval, medium to above in size, bright and attractive, white, good, few days before Carman.

27 BG Belle x Greensboro—large blossom, almost free, oval, large, bright, white, good, mild, few days before Carman, imperfect blossom.

28 BE Belle x Elberta—medium blossom, free, Elberta shape, large, showy, yellow, very fair, with Hiley.

29 EC-E Early Crawford x Elberta—medium blossom, free, Elberta shape, medium size, yellow, quality fair but tending to be acid, several days before Elberta.

30 EC-E Early Crawford x Elberta—medium blossom, free, Elberta shape, medium size, yellow, good, rather sweet, with Belle.

31 EC-E Early Crawford x Elberta—small blossom, semi-free, Elberta shape, medium size, yellow, good, few days before Elberta.

32 EB Elberta x Belle—large blossom, free, Belle shape, above medium, bright color, white, good, with Belle.

33 EB Elberta x Belle—medium blossom, free, Belle shape, large, bright color, white, very fair, between Hiley and Belle.

34 E Elberta S-P—medium blossom, free, Elberta shape, medium size, yellow, better than Elberta, two weeks later than Elberta.

35 E Elberta S-P—medium blossom, semi-free, Elberta shape, yellow, very fair, few days after Elberta (19E).

36 E Elberta S-P—yellow free, medium, after Elberta, imperfect flower.

37 BG Belle x Greensboro—medium blossom, free, oval, medium to above in size, white, very fair, mild sub-acid, Hiley season.

38 EG Elberta x Greensboro—large blossom, semi-free, Elberta shape, large, good crop, highly colored, white, fair, mild, rather sweet, Carman season.

39 EG Elberta x Greensboro—medium blossom, free, Elberta shape, large, good crop, high color, white, fair, mild, with Hiley.

40 CS Carman x Slappey—medium blossom, free, oval, below medium in size, bright color, white, fair, mild, flesh very firm, few days earlier than Carman.

41 SD Slappey x Dewey—medium blossom, free, round oval, large, dark colored, yellow, good, sub-acid, skin tender, with Carman.

42 B Belle S-P—medium blossom, free, Belle shape, slightly pointed, medium, bright golden under color, yellow, very fair, Belle season.

43 EC-E Early Crawford x Elberta—small blossom, free, Elberta shape, large, color good, yellow, very fair, aromatic, Elberta season.

44 EB Elberta x Belle—medium blossom, oval, free, yellow, good, with Elberta (20 EB).

45 E-EC Elberta x Early Crawford—large blossom, free, Elberta shape, size medium to above, yellow, firm, good, with Elberta.

46 B Belle S-P—medium blossom, cling, Belle shape, medium size, yellow, tough, fair, between Hiley and Belle, for commercial canning.

47 BG Belle x Greensboro—medium blossom, oval, free, white, good, mild and sweet, between Carman and Hiley (9 BG).

48 B Belle S-P—medium blossom, Belle shape, free, medium size, white, good, firm, with Hiley.

49 B Belle S-P—small blossom, oval, cling, yellow, very fair, tough, after Elberta, commercial canning.

50 B Belle S-P—medium blossom, oval, cling, yellow, fair, tough, week after Elberta, commercial canning.

51 SA Slappey x Arp—medium blossom, roundish oval, below medium to medium, bright under color, yellow, free, very fair to good, few days before Carman.

52 SD Slappey x Dewey—medium blossom, oval, large, skin a little tender, high quality, week before Carman.

53 LA Lola x Arp—large blossom, oval, below medium, color similar to Arp but brighter, good, cling, yellow, about with Arp.

54 SA Slappey x Arp—medium blossom, tree upright, free, oval, medium, yellow, color bright, good, with Carman.

55 LA Lola x Arp—large blossom, cling, below medium, oval, yellow, good under color, good, with Mayflower.

56 SD Slappey x Dewey—medium blossom, free, roundish oval, medium, yellow, good, about with Carman.

57 B Belle S-P—large blossom, free, Elberta shape, medium to above, yellow, very fair, between Belle and Hiley.

Of these, 49 B, 50 B, 53 L-A, 55 L-A, have not yet been disseminated.

Accessions to Peach Variety Planting

The planting of new peach varieties, as they are introduced, is necessary, in order to make comparisons with our own seedlings as they prove meritorious. In addition to the standard shipping peach now grown, there is a movement to establish a peach-canning industry in the east. Several station seedlings seem desirable for this purpose. For these reasons, it seemed desirable to secure a series of the best varieties used for canning in California.

There are other points of interest in the accessions. George IV is one of the oldest varieties of peaches grown. Strawberry is a variety of New Jersey origin which has been discarded in this state, but is now grown extensively in California as a market peach and as a source of seeds for stock. Vidette, Valiant and Vanity were originated at the Horticultural Experiment Station at Vineland, Ontario.

A list of the accessions is as follows:

Commercial varieties: Bowers September, Fay Elberta, George IV, Imperial, Miller Late, National (by Burbank), Strawberry, Tossetti, Valiant, Vanity, Vidette, Winter; Canning varieties: Hauss, Lubber, McDevitt, Palora, Peake, Seller's Orange, Tuscan; 2 seedlings from J. Howard Lippincott of Riverton, N. J., one a yellow clingstone ripening before Arp and the other a white clingstone ripening between Greensboro and Carman.

In addition to these, 16 new varieties and types, mainly from the office of Foreign Seed and Plant Introduction, have been budded in the nursery and will be set in the orchard the coming autumn.

Fruit Setting on the J. H. Hale Peach

For the third consecutive year, in breeding on trees of the J. H. Hale peach, a branch was allowed to go unpollinated. Again, all of the fruit fell from the unpollinated branch, while a fair set of fruit is to be seen on the branches, the flowers on which were hand-pollinated.

This verifies our findings of previous years that this variety is sterile as a male, and to secure fruit in the orchard should be interplanted with other varieties as pollinators.

FLORICULTURE EXPERIMENTS

Carnation Breeding—Project 9

C. H. CONNORS

No breeding work was done with carnations during the past season. The efforts were devoted to a testing of the various seedlings which have been saved from previous years.

A number of these seedlings appear to be promising. From the commercial standpoint, 3 deep pinks, 2 red, 1 purple and 1 light pink are worthy of further test, and from them some should be disseminated. There are also 5 which should appeal to private gardeners and to fanciers. If these prove up, they will be propagated and disseminated.

Environmental Factors in Hydrangea Culture—Project 14

C. H. CONNORS

The control of color in the hydrangea having been solved in previous years, so far as the pink side is concerned, the efforts for the past season have been devoted to the production of blue color, and to preliminary work in the fundamental reasons for the color changes.

Production of Blue Color

Soils which had been composted for carnation culture and for rose culture were mixed in equal part by bulk, giving a soil of high fertility and good drainage. This mixture had a value of pH 6.8 to 7.2, just about neutral. To this was added aluminum sulfate, ammonium aluminum sulfate, or sulfur, as follows:

Aluminum sulfate was used at the rates of 250 pounds, 500 pounds, 1000 pounds, 2000 pounds, 4000 pounds, 10,000 pounds to the acre 6 inches deep; ammonium aluminum sulfate was used at the rates of 250 pounds, 500 pounds, 1000 pounds, 2000 pounds, 4000 pounds, 10,000 pounds, 20,000 to the acre 6 inches deep; sulfur was used at the rates of 200 pounds, 500 pounds, 1000 pounds, 2000 pounds to the acre 6 inches deep. Ten plants each of 2 varieties were used in each treatment.

Some toxicity was found. Ammonium alum, 20,000 pounds to the acre, was fatally toxic, and all plants were killed. Ammonium alum, 10,000 pounds to the acre, killed all but 2 of the 20 plants. Aluminum sulfate appeared to be slightly toxic in the 10,000-pound application.

All of the plants did not bloom, but the indications are that about 5,000 pounds to the acre six inches deep, in a neutral soil, will cause hydrangeas to bloom blue.

Culture Studies with Hydrangeas

Attempts have been made to grow hydrangeas in cultures in a sand substratum.

Two culture media were used this year. The one suggested by Dr. Henry Kraemer, of the Kraemer Laboratories, Mount Clemens, Michigan, composed of dibasic potassium phosphate, magnesium sulfate and ammonium phosphate was modified in reaction by the use of potassium hydroxide and 0.5*M* sulfuric acid. The concentration was too low, however, and the plants failed to develop well.

The other solution was a modification of Shive's R_1C_2 solution. The modification worked out and suggested by Dr. John W. Shive consisted in substituting monobasic potassium phosphate in part for dibasic potassium phosphate, to secure adjustments in the hydrogen-ion concentration. By this means hydrogen-ion concentrations ranging from pH 4.8 to pH 6.6 were secured.

The plants grew vigorously and flowered, but all were of the same color, regardless of the initial pH of the solution, or whether iron (in the form of Duggar's soluble iron phosphate) or aluminum (in the form of aluminum nitrate) was used. The solutions were changed weekly, but the pH values increased very rapidly, so that all treatments were practically on a par in this respect. A constant drip apparatus will be employed next season.

Accessions

Through the courtesy of Henry A. Dreer, Inc., of Riverton, N. J., there has been added to our collection of hydrangeas the following new varieties of the French forcing type: Beaute Havraise, Coquelicot, Jacques Groenewegen, La Marne, Prof. D. Bois, Splendens, Suzanna Cayeux, Triomphe.

Culture Studies with Ornamentals—Project 22

C. H. Connors

The study of the culture of ornamental plants is a phase of the work in horticulture which may be of benefit to the residents of the large urban and suburban districts. The interest in home ornamentation has been increased immensely in the past few years, as is indicated by an increase in number of local garden clubs, in the federation of the garden clubs in some instances and by the increased demand for advice by individual residents of the state.

Dahlias

Fertilizer work was begun with dahlias during the summer of 1923, but after the fertilizer was applied, not enough rain fell to carry the fertilizer to the roots of the plants. Accordingly the results were negative.

The advantages of disbudding the dahlia to increase the size of the flowers were well shown.

Such extensions as possible were made in the work. The collection of dahlias now includes about 370 varieties, among them the most outstanding varieties of American and European origination. It includes nearly all of the horticultural types. Through the courtesy of Mrs. Charles H. Stout of Short Hills, N. J., the station has come into possession of the most important species, from the standpoint of the modern garden dahlia, namely, Dahlia *coccinia*, D. *variabilis* and D. *Juarezii* and also D. *merckii.*

Dahlia Seedling Test Garden

In cooperation with the Dahlia Society of New Jersey, a seedling test garden was established in 1923, to which 35 seedlings were sent for scoring. The unfavorable weather prevented most of these from blooming, as they were late in being planted.

In 1924, 46 seedlings were submitted by 7 growers. These will be scored and if the proper grade is made, will be awarded the certificate of the Dahlia Society of New Jersey. Since some of the finest dahlias shown last year were of New Jersey origin, the test garden should be a point of interest for all dahlia lovers.

Iris

The iris collection has been enlarged by donations from Mrs. C. S. McKinny of Madison, N. J., and Mr. John C. Wister of Germantown, Pa., until it now consists of about 200 varieties. Work has been started, in cooperation with the departments of Entomology and Plant Pathology, on the control of the iris borer and the rhizome rot.

Peonies

The peony collection contains 41 varieties, given by Mr. James Dymock, gardener for James B. Duke, Esq., and by the Davis Peony Farms, Quinton, N. J.

Gardens

In order to display the perennial plants to the best advantage, an area on the Horticultural Farm has been set aside for this purpose.

Nine beds approximately 70 feet long and 10 feet wide have been laid out with grass walks between. The width admits of three rows of planting with sufficient space for horse or garden tractor cultivation. These have been planted in part with peonies, iris, phlox and roses, and, properly labelled, afford easy access for the examination of the various varieties. The same plan is projected for the general list of hardy perennial plants. In addition, the formation of permanent shrub and herbacious perennial borders is now under way, to show proper combinations for effect, planting distances and other features of garden ornamentation.

Methods in Greenhouse Propagation—Project 23

C. H. CONNORS

Accelerating Root Formation in Carnation Cuttings

Any method of shortening the period required for the production of plants is an asset. If the period required for rooting cuttings is reduced, this means decreased cost of production.

Some years ago a publication from Cornell pointed out that potassium permanganate would accelerate root formation in hardwood cuttings, privet being the subject used. With soft cuttings not much success was obtained. This matter has been in the writer's mind for some time, and an incident during the spring of 1923 suggested that

there might be some further merit in this treatment. It so happened that hydrangeas had to be propagated, and no sand was available except that used for carnation cuttings. The germicidal and fungicidal value of potassium permanganate is known and has been suggested for the control of damping off with certain plants. The old sand was saturated with a solution of potassium permanganate, and, after it had drained out (next day), the hydrangea cuttings were stuck. In 6 weeks they were taken out, and proved to have uniformly well-developed root systems, and stronger root systems, it seemed, than normal.

This winter it was decided to try this material upon carnation cuttings.

Flats were divided into 2 compartments, sand placed therein and then soaked with solutions of potassium permanganate, 1 to 1,000 ($^1/_{10}$ of 1 per cent), and 1 to 2,000 ($^1/_{20}$ of 1 per cent). One compartment was saturated with water for a check. Later in the same day (December 24) 66 cutting of Enchantress Supreme were stuck in each compartment. The cuttings were general run, no attempt being made to select them.

The flats were placed on top of the sand in a propagating house. Bottom heat was under the bench for only the first 2 weeks.

On February 20, 58 days later, the cuttings were removed. This is a period of about 8 weeks, but, since there was no bottom heat, the difference between the usual 6 weeks with bottom heat and this period of 8 weeks with no bottom heat is explicable.

When the rooted cuttings were removed, the first fact to strike the workman was the large root systems of the cuttings out of the 1:1000 treatment. The next fact was the remarkable *uniformity* of the root systems from this treatment. This is very well shown in the illustrations. Figure 1 shows the best 10 from the check, 1:2000 and 1:1000, the sand having been washed from the roots. Figure 2 shows the second best 10 from the control compared with the poorest 10 from the 1:1000.

Even this does not completely tell the story. The remaining cuttings from the control were very poorly rooted, most of them with very little roots showing, while all those of the treated lots showed well-developed roots.

Potassium permanganate is a slow-acting germicide and fungicide and is also an oxidizing agent. It is to the latter quality that the results above are probably due, the oxygen given off accelerating the formation of the callus.

This treatment is safe, if the excess is allowed to drain away, and can probably be used with practically all cuttings, although it would be well to try it experimentally at first. The treatment consists in applying, by means of a watering pot, a solution of 1 ounce of potassium permanganate in 8 gallons of water, at the rate of 1 gallon to the square foot. Its effect upon carnation cuttings in the 1:1000 dilution was to shorten the period of root production at least a week, to influence the uniform striking of roots by the cuttings and the production of uniform root systems.

PLATE 1

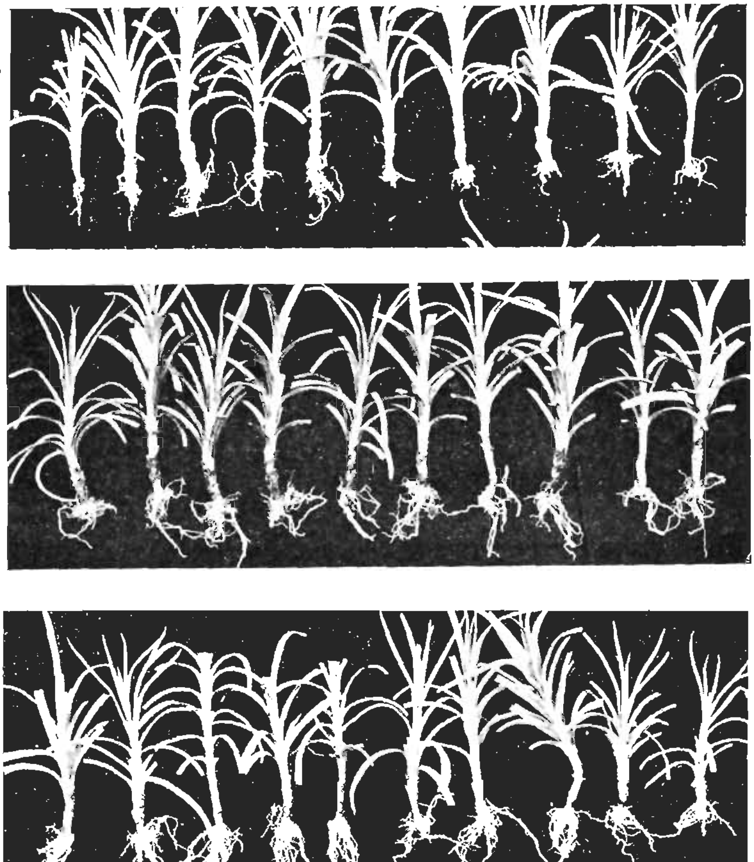
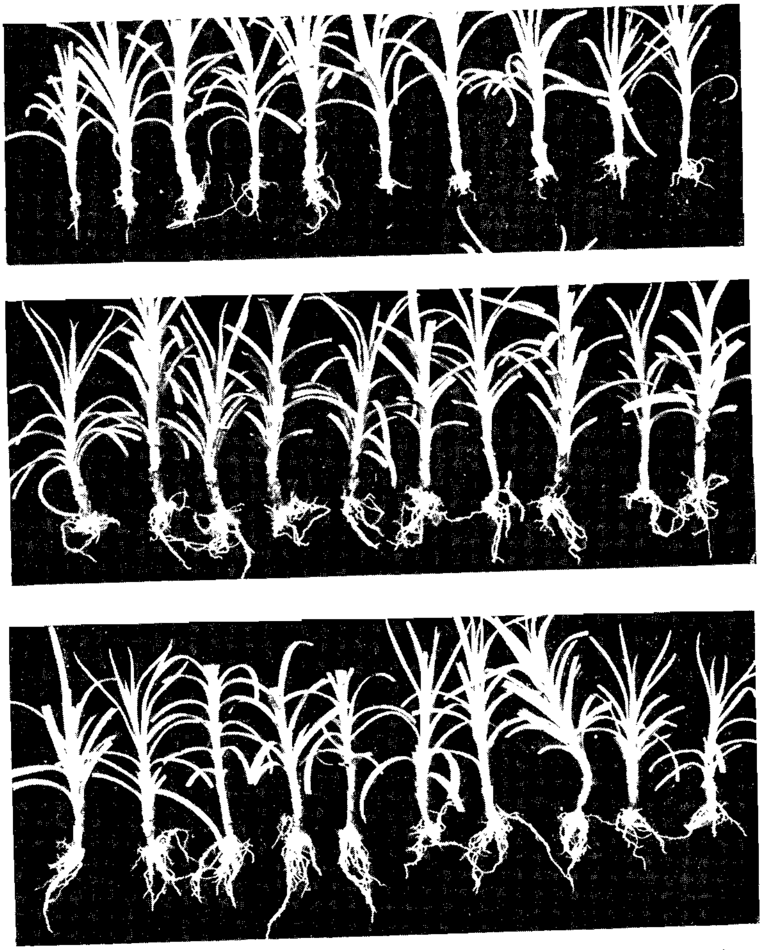


*Fig. 1. *Root formation of carnation cuttings. Best 10 from 66 in each case*

A—Control.
B—1 to 2000 Potassium Permanganate.
C—1 to 1000 Potassium Permanganate.

PLATE 1



•Fig. 1. Root formation of carnation cuttings. Best 10 from 66 in each case

A—Control.
B—1 to 2000 Potassium Permanganate.
C—1 to 1000 Potassium Permanganate.

PLATE 2

FIG. 2. Root formation of carnation cuttings

A – Second best 10 of 66 – Control.
B – Poorest 10 of 66 – 1 to 1000 Potassium Permanganate.

PLATE 2

FIG. 2. Root formation of carnation cuttings

A—Second best 10 of 66—Control.
B—Poorest 10 of 66—1 to 1000 Potassium Permanganate.

REPORT OF VEGETABLE DEPARTMENT

L. G. SCHERMERHORN

Plant-Food Studies with Tomatoes—Project 13

Experiment 1

The fertilizer comparisons in this experiment were discontinued during the season of 1923 owing to an attack of tomato wilt. The fertilizer comparisons will be carried on in 1924 with Chantenay Carrots from Vilmorin, of Paris, France, and Newark Market Celery from Alexander Forbes & Co., of Newark, N. J.

Experiment 2—Tomato Fertilizer Triangle

The growing of tomatoes on this series of plots was discontinued late in June owing to a severe outbreak of tomato wilt. The plots were planted to Howling Mob Sweet Corn (Station Strain). The plots were $^1/_{40}$ acre in extent and each contained 132 hills of corn, the rows being 3 feet apart and the hills 2¾ feet apart. The sweet corn was graded into two grades. Those ears that were filled out and of average size, 6 inches in length or above, were considered as marketable, and all ears not well filled and that fell below 6 inches in length were considered as unmarketable. The dry season of 1923 undoubtedly accounts for the large number of unmarketable ears recorded. Table 10 gives the results secured with the sweet corn in 1923. This series of plots will be planted to Howling Mob Sweet Corn (Station Strain) again in 1924.

Plant-Food Studies with Sweet Potatoes—Project 14

Plant-food and hill selection studies with sweet potatoes were conducted in Atlantic and Ocean Counties in 1923. The objects of the experiments were (a) to secure information as to the best combination of fertilizer ingredients, (b) to determine the best sources of nitrogen, (c) to determine which ingredients are most essential, (d) to study some of the factors influencing the shape of the sweet potato, (e) to determine the influence of amounts and time of applying nitrogen, (f) to determine the value of hill and tuber-unit selections.

Ocean County Studies

The 21-mixture fertilizer triangle was started in 1923, but owing to the very dry season and the conditions under which the plants were grown the results are of no value as experimental data.

In 1923 the experiments conducted at George Newman's were for the purpose of studying (a) the influence of potash on the yield and

TABLE 10

Sweet Corn Fertilizer Triangle, 1923

Plot	Treatment	Series I Marketable Ears	Series II Marketable Ears	Average Marketable Ears
1	Check	7171	8814	7993
2	2-12-2	8815	10015	9415
3	2-10-4	11492	9166	10329
4	4-10-2	12432	10474	11453
5	2-8-6	10227	10113	10,170
6	4-8-4	9082	10099	9591
7	6-8-2	10602	9521	10062
8	2-6-8	12185	9504	10845
9	4-6-6	9262	10360	9811
10	6-6-4	8952	9450	9201
11	8-6-2	10462	8522	9492
12	Check	12420	9090	10755
13	2-4-10	7920	11700	9810
14	4-4-8	8690	9870	9280
15	6-4-6	11840	10012	10926
16	8-4-4	9780	9050	9415
17	10-4-2	8050	7922	7986
18	2-2-12	10560	9528	10044
19	4-2-10	8628	9765	9197
20	6-2-8	10096	8570	9323
21	Check	9250	8290	8770
22	8-2-6	6985	8160	7573
23	10-2-4	9490	8820	9155
24	12-2-2	8680	8660	8670

form of the sweet potato, (b) the influence of different amounts of and time of applying nitrogen and (c) the influence of hill and tuber-unit selections.

The results secured from this series of plots are found in table 11. The low yields may be attributed to the dry season in 1923.

The dry weather at planting time made it necessary to replant a large part of the field, and due to the continued dry weather during the growing season the replants had made a very small amount of growth before digging time, thus reducing the yield of large marketable potatoes.

Atlantic County Studies

The series of fertilizer comparisons started in 1922 on the farm of J. L. Purzner, at Germania, N. J., were continued in 1923. The object of this work is to study sources of nitrogen and the value of potash in sweet potato production.

The rows were made up with 600 lbs. per acre of each fertilizer mixture under the row. The rows were 3½ feet apart and the plants 18 inches apart in the row. One hundred and eighty-seven plants were used in each row, or $^{1}/_{40}$ of an acre. The plants were set with

TABLE 11

Influence of Amounts and Time of Applying Nitrogen and Influence of Potash on Yield and Form

Plot No.	Fertilizer Treatment	Series I		Series II		Average	
		Firsts	Seconds	Firsts	Seconds	Firsts	Seconds
1	Check—No fertilizer	82.3	67.8	37.4	53.0	59.8	63.8
2	600 A.P. 200 KCl 100 $NaNO_3$	128.8	64.8	41.5	47.4	85.1	56.1
3	600 A.P. 200 KCl 50 $NaNO_3$ and 50 $NaNO_3$ Side Dress.,	137.0	64.0	40.1	62.6	88.5	63.3
4	600 A.P. 200 KCl and 100 $NaNO_3$ as side dressing	99.5	48.2	50.8	27.9	75.1	38.0
5	1400 lbs. 3-8-8 Muriate of Potash	140.0	66.0	118.0	74.9	129.0	70.4
6	1400 lbs. 3-8-8 Sulfate of Potash	132.1	69.6	54.2	76.3	93.1	72.9
7	1800 lbs. 3-8-8	94.1	60.3	87.7	59.3	90.9	59.8
8	1000 lbs. 3-8-8	71.2	64.8	156.3	62.9	113.2	63.8
9	Check—No fertilizer	70.3	43.4	35.2	65.6	52.7	54.5
10	1400 lbs. 3-8-0	23.7	70.0	107.7	76.3	65.7	73.1
11	300 A.P. 100 KCl 50 $NaNO_3$ same as side dressing	78.1	46.7	73.7	56.8	75.9	48.7
12	600 A.P. 200 KCl 300 $NaNO_3$	46.7	62.9	56.4	49.3	51.5	56.1

a transplanter the latter part of May and dug October 11 and 12, 1923.

The sources of nitrogen compared were nitrate of soda, sulfate of ammonia, tankage and dry ground fish alone and in combination.

The value of potash is shown in plots 1, 10, 12, 13, 14, 15, 16, 17 and 18, the range in yield being 24.1 bushels of firsts and 32 bushels of seconds from the 3-8-0, to 114.7 bushels of firsts and 52.5 bushels of seconds from the 3-8-6, and 84.2 bushels of firsts and 56.9 bushels of seconds from the 3-8-8 fertilizer mixtures. The dry weather at planting time made it necessary to make a large number of replants. The replants made a very small amount of growth owing to the continued drought. This accounts for the low yields secured in 1923. The results secured in 1923 are found in table 12.

Hill and Tuber-Unit Selection Studies

The hill and tuber-unit studies begun in 1922 have been continued in 1923.

The outstanding features of the sweet potato experiments will be published in bulletin form during the summer of 1924.

Plant-Food Studies with Asparagus—Project 19

Experiment 1

The plant-food studies with asparagus begun in 1922 on the Horticultural Farm at New Brunswick consist of 8 fertilizer and manure comparisons. Because the season of 1923 was a very dry one the yields are slightly below normal for the age of the beds. The cutting season of 1924 was very wet and cool, therefore a very decided decrease in yield will probably be noted when the results are summarized.

The results secured during the cutting season of 1923 are found in table 13.

Experiment 2

At the request of the Gloucester County Board of Agriculture, the vegetable department has begun a series of experiments on the farm of Herbert Borden, at Mickleton, N. J. The objects of these experiments are: (a) to determine the influence of nitrogen, phosphoric acid and potash in asparagus production, (b) to determine the value of green manure as a substitute for stable manure, (c) to study the influence of common salt, (d) to study the influence of lime.

In the spring of 1923 the asparagus bed for these experiments was planted with 1-year-old Palmetto asparagus roots, in rows 5 feet 3 inches apart, with the roots 3 feet apart. The entire field received a uniform application of 1,000 pounds of a 5-8-7 at that time.

In the spring of 1924, 64 one-fortieth-acre plots 51.7 by 21.2 feet were laid out with 2 feet between each plot. Each plot contains 4 rows of asparagus.

Table 12

Sweet Potato Yields Per Acre, Atlantic County, 1923

Fertilizer Treatments	Series I		Series II		Average	
	Firsts	Seconds	Firsts	Seconds	Firsts	Seconds
	bu.	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*
Check	2.6	4.0	5.7	15.8	3.9	10.1
1200 2-8-6 All $NaNO_3$	79.0	44.4	81.9	56.4	80.5	50.4
1200 2-8-6 ½ $NaNO_3$ ½ $(NH_4)_2SO_4$	56.3	69.9	89.0	56.1	72.6	63.0
1200 2-8-6 ½ $NaNO_3$ ½ Tankage	74.0	41.0	73.5	57.6	73.2	49.3
1200 2-8-6 ½ $NaNO_3$ ½ Fish	89.2	49.5	110.5	47.1	99.8	48.3
1200 2-8-6 All $(NH_4)_2SO_4$	80.3	52.5	64.7	53.7	72.5	53.1
1200 2-8-6 All Tankage	63.4	63.4	89.7	56.4	76.5	59.5
1200 2-8-6 All Fish	104.7	43.0	68.5	54.7	86.2	48.8
1600 4-8-6 ½ $NaNO_3$ ½ $(NH_4)_2SO_4$	71.5	93.5	94.0	35.5	82.7	64.5
1200 2-8-10	94.3	63.2	93.6	51.6	93.9	57.4
1200 4-8-6	82.7	51.3	88.5	62.9	85.6	57.1
Check	6.4	18.4	22.6	20.4	14.5	19.4
1200 2-8-0	21.4	24.6	29.8	19.1	25.6	21.8
1200 2-10-4	74.2	51.8	62.5	77.5	68.3	69.1
1400 3-8-3	75.9	47.0	92.5	66.8	84.2	56.9
1800 3-8-8	83.7	53.7	113.9	44.5	98.8	49.1
1400 3-8-6	79.7	54.6	149.7	50.4	114.7	52.5
1400 3-8-4	101.5	50.7	100.0	70.7	100.7	60.7
1400 3-8-0	26.7	20.1	20.5	44.0	24.1	32.0
1400 3-8-8 $(NH_4)_2SO_4$	99.7	56.1	123.9	49.4	111.8	52.7

TABLE 13

Asparagus Yield Per Acre, 1923

Plot No.	TREATMENT	Wolpert Farm			Morrissey Farm		
		Firsts	Seconds	Total	Firsts	Seconds	Total
		lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
1	Manure alone—10 tons per acre	1410	598	2008	2030	1453	3483
2	Manure 10 T. and 750 lbs. acid phos.—150 lbs. $NaNO_3$ in the spring and 250 lbs. $NaNO_3$ after cutting	1518	667	2185	2016	1588	3604
3	Manure 10 T. and 750 lbs. acid phos. All in spring	1446	573	2019	2240	1543	3783
4	Manure 10 T. spring and 1500 lbs. 4-8-4 all after planting,	1624	679	2303	2401	1567	3968
5	Manure 10 T. and 500 lbs. 4-8-4 (spring) and 1000 lbs. 4-8-4 after cutting	1698	624	2322	2297	1537	3834
6	Manure 10 T. spring and 750 lbs. 4-8-4 after cutting	1334	549	1883	2202	1556	3758
7	Manure 10 T. and 500 lbs. 4-8-4 (spring) 1000 lbs. 4-8-4 after cutting and leguminous cover crop	1396	462	1858	1932	1429	3361
8	Same as plot 7 and non-leguminous cover crop	1122	507	1629	2160	1528	3688

TABLE 14

Veneer Band vs. Field-Planted Seed and Fertilizer Tests and Yields Per Acre, 1923

FERTILIZER TREATMENTS	Method of Starting the Plants	Series I		Series II		Average	
		Firsts	Seconds	Firsts	Seconds	Firsts	Seconds
		baskets	*baskets*	*baskets*	*baskets*	*baskets*	*baskets*
Manure alone	Veneer Bands	153.33	120.00	173.33	140.00	163.33	130.00
Manure alone	Field Planted	95.75	151.25	30.00	80.00	62.87	115.62
Manure and 500 lbs. acid phos.	Veneer Bands	163.33	127.50	146.67	127.50	155.00	127.50
Manure and 500 lbs. acid phos.	Field Planted	110.00	227.50	40.00	135.00	75.00	181.20
Manure and 500 lbs. 4-8-4	Veneer Bands	116.67	192.50	110.00	132.50	113.33	162.50
Manure and 500 lbs. 4-8-4	Field Planted	80.00	117.50	86.50	189.25	83.25	153.12
Manure 500 lbs. 4-8-4, 150 lbs. $NaNo_3$ side dressing	Veneer Bands	96.67	132.50	123.00	177.00	109.83	154.80
Manure 500 lbs. 4-8-4, 150 lbs. $NaNo_3$ side dressing	Field Planted	60.00	112.50	63.33	87.50	61.66	100.00
Rye and 150 lbs. KCl and 450 A. P., 250 tankage under hills, 100 lbs. $NaNo_3$ and 100 lbs. Fish	Veneer Bands	213.33	135.00	170.00	152.50	191.66	143.75
Rye and 150 lbs. KCl and 450 A. P., 250 tankage under hills, 100 lbs. $NaNo_3$ and 100 lbs. Fish	Field Planted	130.00	172.50	46.67	92.50	88.34	132.50

12 melons—1-basket firsts
16 melons—1-basket seconds

Muskmelon Studies—Project 20

The muskmelon studies in 1923 included (a) comparisons of plants started under glass, with field-planted plants, and (b) fertilizer comparisons.

The first experiment was conducted to determine the influence on the earliness and yield of the crop of starting muskmelons under glass. The hills of melons were started under glass April 20, and set in the field May 20. On the same date seed was planted under the same soil and fertilizer conditions. The results secured in 1923 were similar to those secured in 1922, the first picking being made from the veneer-band plants on August 3, and from the field-planted plants on August 17. The variety used was Early Night.

For fertilizer treatments and yields see table 14.

The most outstanding feature of the fertilizer study in 1923 is the result secured from treatment 9 on which no manure was used. This same plot gave the highest yield in 1922.

Influence of Amount and Time of Applying Nitrate of Soda on Sweet Corn, Tomatoes and Peppers—Project 25

This is a new series of fertilizer treatments, the object of which is to determine the influence upon the yield of: (a) time of applying nitrate of soda, and (b) amount of nitrate of soda.

These experiments were conducted at New Brunswick on Howling Mob Sweet Corn (Station Strain), Greater Baltimore Tomatoes and Ruby King Peppers.

The results secured in 1923 are found in tables 15, 16 and 17.

TABLE 16

Influence of Amounts and Time of Applying Nitrate of Soda
Tons Per Acre Greater Baltimore Tomatoes

TREATMENTS	First Series	Second Series	Average
Check	8.99	6.55	7.77
600 A.P. 200 KCl 100 $NaNO_3$	13.02	12.78	12.9
600 A.P. 200 KCl 200 $NaNO_3$	12.93	17.98	15.45
600 A.P. 200 KCl 300 $NaNO_3$	16.18	13.72	14.95
600 A.P. 200 KCl 50 $NaNO_3$ Side Dressing 50 $NaNO_3$	14.23	12.35	13.29
300 A.P. 100 KCl 50 $NaNO_3$ Same as Side Dressing	19.23	13.96	16.59
600 A.P. 200 KCl Side Dressing 100 $NaNO_3$	10.34	8.71	9.52
600 A.P. 200 KCl 150 $NaNO_3$ Side Dressing 150 $NaNO_3$	11.41	11.12	11.26
Check	4.03	11.11	7.57

TABLE 15

Influence of Amounts and Time of Applying Nitrate of Soda
Ears Per Acre of Howling Mob Sweet Corn

TREATMENTS	Series I		Series II		Average	
	Marketable	Unmarketable	Marketable	Unmarketable	Marketable	Unmarketable
Check	8875	2765	8778	3444	8826	3104
600 A.P. 200 KCl 100 $NaNO_3$	8391	3880	8730	3540	8560	3710
600 A.P. 200 KCl 200 $NaNO_3$	7373	3880	9160	4409	8266	4144
600 A.P. 200 KCl 300 $NaNO_3$	7324	3201	8520	2523	7922	2862
600 A.P. 200 KCl 50 $NaNO_3$ / Side Dressing 50 $NaNO_3$	8682	4025	9700	2862	9191	3443
200 A.P. 100 KCl 50 $NaNO_3$ / Same as Side Dressing	10330	3978	9450	2900	9890	3439
600 A.P. 200 KCl / Side Dressing 100 $NaNO_3$	6320	3674	9943	3298	8131	3486
600 A.P. 200 KCl 150 $NaNO_3$ / Side Dressing 150 $NaNO_3$	8132	3184	9600	4305	8866	3744
Check	7706	4311	10525	2910	9115	3610

TABLE 17

Influence of Amounts and Time of Applying Nitrate of Soda
Ruby King Peppers—Fruits Per Acre

TREATMENTS	First Series		Second Series		Average	
	Tons	Count	Tons	Count	Tons	Count
Check	4.22	65,200	4.40	69,810	4.31	67,505
600 A.P. 200 KCl 100 $NaNO_3$	6.13	88,800	5.95	91,190	6.04	89,995
600 A.P. 200 KCl 200 $NaNO_3$	....	....	....	....	....	....
600 A.P. 200 KCl 300 $NaNO_3$	....	....	....	....	....	....
600 A.P. 200 KCl 50 $NaNO_3$ Side Dressing 50 $NaNO_3$	6.06	94,750	5.20	89,450	5.63	92,100
200 A.P. 100 KCl 50 $NaNO_3$ Same as Side Dressing	5.40	94,300	5.24	89,530	5.32	91,915
600 A.P. 200 KCl Side Dressing 100 $NaNO_3$	6.70	108,730	5.29	92,330	6.30	100,530
600 A.P. 200 KCl 150 $NaNO_3$ Side Dressing 150 $NaNO_3$	5.64	100,740	6.10	102,300	5.87	101,520
Check	....	....	....	....	....	....

Miscellaneous Vegetable Studies in Northern New Jersey—Project 21

H. F. HUBER

All the experimental work included in this project was carried on at the North Jersey Experimental Plots, located on the farm of G. L. Fisher, Athenia, N. J. These plots consist of 3 acres of land leased by the Passaic County Board of Agriculture and presented to the experiment station for 5 years for conducting experiments with the important vegetable crops of the market garden sections of northern New Jersey. A committee consisting of 4 members of the Passaic County Board of Agriculture and 5 members of the staff of the experiment station act as advisors in the work.

The area under cultivation is 171 feet by 634 feet, and is divided into four strips lengthwise. The first strip is used for plant-food studies with lettuce and cauliflower, the second for plant-food studies with spinach, the third for variety tests of cauliflower, lettuce and spinach, and the fourth for studies in sources of nitrogen in lettuce fertilizers combined with cover crop and manure comparisons. The soil on these plots is a brown phase of Wethersfield loam which is somewhat heavy and very stony. This type of soil is quite general in the Richfield and Brookdale sections.

Work was started at these plots in the fall of 1922. The first experiments started were to determine the causes and possible control measures for a "yellowing" of spinach, which is a serious trouble of the fall spinach crop in this section. The yellows failed to appear, but some valuable results were obtained in the fertilizer and variety comparisons. These have been published in bulletin 385 of this experiment station.

In the spring of 1923 further experimental work with cauliflower and lettuce was started. The experiments now under way consist of:

1. Spinach-yellowing studies.
2. Plant-food studies with cauliflower.
3. Variety study with cauliflower.
4. Plant-food studies with lettuce.
5. Variety study with lettuce.
6. Sources-of-nitrogen studies with lettuce.

The extra work required considerable labor for planting, cultivating and harvesting, and made it necessary to employ a man to devote his entire time to caring for the plots. Additional labor was required at various times, particularly at planting and harvest.

Experiment 1—Spinach-Yellowing Studies

The work started in the fall of 1922 was repeated in 1923 with the addition of more strains and varieties in the variety test. The spinach plots were plowed the latter part of April, 1923. The variety plot received a coat of 10 tons of manure plowed under and 1,600

pounds of 4-8-4 harrowed in. Lettuce and cauliflower varieties were grown there during the spring. They received, in addition to the fertilizer, a side dressing of 150 pounds of nitrate of soda. Buckwheat was sown May 11 on the fertilizer plots to furnish organic matter. The plots were again plowed July 9.

Variety Studies, 1923

Forty different lots of spinach seed comprising 14 varieties were tested. Fourteen lots were purchased by the experiment station and the balance were secured from various growers in Bergen, Essex, Morris and Passaic Counties.

The variety plot received 1,600 pounds of a 4-8-4 fertilizer applied August 20. The seed was sown August 24 in 12-inch rows, 2 rows, each 50 feet long, being planted to each variety. The unusually dry season reduced the stand somewhat and made the early growth of the plants very slow. During the week of September 23 a period of warm, damp weather, with several rainy days, favored the development of damping-off. The reduction in stand was uniform throughout the variety plots. On October 4 records were taken on the stand of the different varieties. The results as shown in table 18 give some indication of the wide variation in vigor of germination and vitality among the different lots.

After the middle of October, spinach fields on neighboring farms began to show signs of yellowing, and some yellowing appeared on the variety plot. Spinach plants were sent to the Virginia Truck Experiment Station, Norfolk, Va., where the trouble was diagnosed as spinach "yellows" or mosaic. The Disease Resistant Savoy strain, which has been developed by the Virginia Experiment Station, proved highly resistant to the disease in the variety tests. Records were taken of the percentage of visibly infected plants in the variety tests on November 5.

On November 12 and 13 the spinach was harvested by cutting just below the crown, and weighed. The total yield of the 2 rows of each variety, computed on an acre basis and expressed in crates of 18 pounds each, is shown in table 9.

Savoy (Bloomsdale or Norfolk Savoy) is the favorite variety in most parts of the state for fall planting; 14 of the 40 lots tested were strains of this variety. A wide variation was found among the strains of Savoy—one yielding 664 crates per acre, another only 88 crates per acre. The 3 highest-yielding Savoy strains are as follows:

Plot	NAME	Seedsman	Crates per A.
11	Disease Resistant Savoy	H. Henninger	664
22	Savoy	S. D. Woodruff	558
24	Savoy	V. B. Webber	420

PLATE 3

Variety Plot Sown August 29. Picture Taken Spring, 1923—Showing the Ability of Disease-Resistant Savoy to Withstand the Winter.

While the Savoy spinach is almost the universal choice for fall planting, it is undesirable for sowing in the spring because it shoots to seed quickly. Varieties more resistant to heat are grown then.

Some of the leading varieties of this class that were tested are as follows:

Plot	NAME	Seedsman	Crates per A.
10	Thick Leaf Viroflay	Alex. Forbes	516
13	Round Leaved Flanders	Carter Seed Co.	495
7	Round Seeded Savoy	H. A. Dreer	486

The high yield obtained from seed of the Disease Resistant Savoy may be explained by the fact that it has been grown locally and carefully rogued for three generations. The original lot of seed was obtained from the Virginia Experiment Station.

In connection with the behavior of the Disease Resistant Savoy in the variety test its ability to winter-over is interesting. The only variety which survived the winter on the plots, with no apparent injury, was a lot of Disease Resistant Savoy obtained from the Virginia Experiment Station and the Disease Resistant Savoy from H. G. Henniger.

TABLE 18

Variety Test of Spinach

Plot	VARIETY	Seedsman	Seed Obtained By	Average Stand	Average Yellows	Acre Yield
					per cent	crates
1	Prickly Seeded	Burpee	N. J. Experiment Station	Good	9	324
2	Victoria	Forbes	N. J. Experiment Station	Fair	20	129
3	Long Standing	Harris	N. J. Experiment Station	Fair	19	218
4	King of Denmark	Harris	N. J. Experiment Station	Fair	13	133
5	All Seasons	Fottler-Fiske Rawson	N. J. Experiment Station	Good	11	284
6	Triumph	Fottler-Fiske Rawson	N. J. Experiment Station	Good	10	265
7	Round Seeded Savoy	Dreer	N. J. Experiment Station	Very Good	9	486
8	Crumpled Leaf	F. H. Woodruff	N. J. Experiment Station	Good	7	404
9	Long Season	Forbes	N. J. Experiment Station	Fair	16	156
10	Thick Leaved Viroflay	Forbes	N. J. Experiment Station	Good	10	516
11	Disease Resistant Savoy	Henniger	Herman Henniger	Very Good	1	664
12	Norfolk Savoy	Forbes	N. J. Experiment Station	Very Good	11	351
13	Round Leaved Flanders	Carter	N. J. Experiment Station	Good	10	495
14	King of Denmark (Emerald Standing)	Otto Stumpp	G. W. Haase, River Edge	Fair	4	159
15	Bloomsdale Savoy	J. H. Ferdinand	John Clausen, Hackensack	Poor	21	98
16	Long Standing	Otto Stumpp	John Clausen, Hackensack	Poor	17	47
17	New York Market	Stumpp & Walter	Henry Clausen, Little Ferry	Poor	5	18
18	Kroemer's Perfection	W. Kroemer	F. Brandenberg, No. Arlington	Good	8	160
19	Long Standing	Otto Stumpp	Wm. Stockhoff, No. Arlington	Good	10	144
20	New Summer	Forbes	Wm. Stockhoff, No. Arlington	Good	12	207
21	Long Standing	Otto Stumpp	G. S. Haase, River Edge	Fair	15	82
22	Savoy	S. D. Woodruff & Sons	R. W. DeBaun, Pine Brook	Very Good	6	558
23	Savoy	Eberle	Henniger & Bender, Richfield	Very Good	14	352
24	Savoy	V. B. Webber	Henniger & Bender, Richfield	Very Good	11	420
25	Long Season	Eberle	Henniger & Bender, Richfield	Good	11	109

TABLE 18—Continued

Variety Test of Spinach

Plot	VARIETY	Seedsman	Seed Obtained By	Average Stand	Average Yellows	Acre Yield
					per cent	*crates*
26	Long Season	F. H. Woodruff	Henniger & Bender, Richfield	Fair	8	116
		W. Kroemer	Henniger & Bender, Richfield	Good	13	290
27	Victoria	F. H. Woodruff	Henniger & Bender, Richfield	Fair	10	194
28	King of Denmark	V. B. Webber	Chas. Walker, Richfield	Fair	11	124
29	Bloomsdale Savoy	Forbes	John Englebrecht, Athenia	Good	10	183
30	Savoy	Wm. Kroemer	John Englebrecht, Athenia	Very Good	9	364
31	Bloomsdale Savoy	V. B. Webber	John Englebrecht, Athenia	Very Good	13	184
32	Savoy	F. H. Woodruff	John Englebrecht, Athenia	Good	24	189
33	Bloomsdale Savoy	V. B. Webber	John Ollwerther, Richfield	Fair	18	88
34	Improved Long Standing	V. B. Webber	John Ollwerther, Richfield	Good	30	274
35	Thick Leaf	Wm. Kroemer	Robert Axt, Brookdale	Good	22	244
36	Long Season	Wm. Kroemer	Robert Axt, Brookdale	Good	......	145
37	Savoy	I. N. Simon	Robert Axt, Brookdale	Very Good	15	343
38	Savoy	Otto Stumpp	Robert Axt, Brookdale	Very Good	11	348
39	Long Standing	Carters	N. J. Experiment Station	Good	11	195
40	Bloomsdale	Forbes	C. L. Fisher, Athenia	Very Good	11	331

Weight of spinach in crate—18 lbs.

Fertilizer Experiments with Spinach, 1923

The soil of the fertilizer-experiment plots was the same as that in the variety plots. It was limed at the rate of 3,000 pounds hydrated lime per acre in the fall of 1922. A cover crop of buckwheat, to furnish organic matter, was plowed under July 9, 1923. Fertilizer was applied August 20 on the various plots as shown in table 19, making the second year that they received these treatments.

The plots in these experiments measured 17 by 64.1 feet, and were, approximately, $^1/_{40}$ of an acre. They were separated by walks 2 feet wide. A sowing of 8 rows in each plot was made August 24 for the fall crop and a second sowing of 8 rows September 14 for wintering over. Rows were sown 12 inches apart. The variety used was Blight Resistant Bloomsbury Savoy obtained from George Tait & Sons, Norfolk, Va.

Damp, dull weather during the week of September 23 caused considerable losses from damping off, the greatest amount of it occurring on the check plots. A scant and irregular supply of rainfall during the other weeks checked the growth of the plants on the plots. The second planting failed to make enough growth to winter-over satisfactorily. The first planting developed a crop which was harvested November 1 and November 13, 14, but the yields were considerably lower than the previous year. The results are shown in table 19.

TABLE 19

The Effect of Various Fertilizer Treatments Upon the Yields of Spinach

Plot	TREATMENT	Crates per Acre*		
		Series A	Series B	Average
16	1600 lbs. 9-8-3 at planting	340	239	289
17	1600 lbs. 9-8-3 in 2 applications†	311	238	275
18	1200 lbs. 9-8-3 in 3 applications‡	178	199	188
19	Check—no fertilizer	101	139	120
20	400 lbs. 9-8-3 at planting	134	216	175
21	800 lbs. 9-8-3 at planting	142	337	240
22	1000 lbs. 9-8-3 at planting	178	393	286
23	1200 lbs. 9-8-3 at planting	203	346	275
24	Check—no fertilizer	122	178	150
25	500 lbs. 4-8-4—10 tons manure at planting	411	331	371
26	1000 lbs. 4-8-4 at planting	302	288	295

*Weight of spinach in crate—18 lbs.
†Second application October 4.
‡Second application September 12, third application October 4.

Experiment 2—Plant-Food Studies with Cauliflower

Cauliflower is one of the important spring crops in the market-gardening sections of the northern part of the state. The crop is not considered a "sure" crop, such as beets and carrots. In addition to losses from insects and diseases, which are well understood by the growers, there are sometimes heavy losses from other unfavorable conditions, such as seed, weather, fertilizer and incorrect cultural practices.

In order to secure some information on the effect of various fertilizer treatments on the growth and yield of cauliflower a series of fertilizer experiments was laid out. These experiments were planned to study:

1. The value of manure alone, and in combination with a moderate amount of commercial fertilizer.
2. The effect of a small, moderate and heavy application of a standard 4-8-4 fertilizer mixture.
3. The value of acid phosphate alone and in connection with a side dressing of nitrate of soda.
4. The effect of one and two applications of nitrate of soda as side dressings in connection with a standard 4-8-4 mixture.
5. The value of fractional applications of a standard 4-8-4 mixture.

The plants used in this experiment were raised at the College Farm, New Brunswick, N. J. Seed of the Catskill Snowball variety from Alex. Forbes & Co. was sown in flats in the greenhouse March 16. The plants were kept growing steadily, and on March 28 they were spotted into flats 2 by 2 inches. April 13, 14 they were transplanted to 3 by 3 by 3-inch veneer bands in flats. The plants were moved to the cold-frame for hardening April 23. On May 1 and 2 the flats of plants were hauled to the plots by truck and planted May 2.

The plants were set 24 inches apart in 30-inch rows. The plots measured 20 feet by 20 feet 9 inches, and were a little less than $^1/_{100}$ acre in extent. Seventy plants were set in each plot. Each treatment was duplicated.

The soil of the plots is a brown phase of Wethersfield loam. Manure was applied to plots A-22, 23, 24; B-22, 23, 24 on April 17. The plots were plowed April 18, harrowed and the fertilizer immediately applied and harrowed in. Nitrate of soda at the rate of 150 pounds per acre was applied to plots A-24, 30, 33 and B-24, 30, 33 on March 14. A second application of the standard 4-8-4 mixture was applied to plots A-29, B-29 on May 14. A second application of nitrate of soda at the rate of 150 pounds per acre was applied to plots A-31, 33 and B-31, 33 on June 5.

A solution of corrosive sublimate 1 to 1,000 was used to control the cabbage maggot. This was applied May 7 and May 17. The heads were protected from the sun by breaking some of the large leaves over them.

The first cutting of cauliflower was made June 14, and cuttings were made at intervals of three or four days until July 5. The stems were cut just below the lowest leaves, and the weight of head and leaves was taken. Three grades were made—firsts, marketable; seconds, marketable, and culls which were unmarketable. The grading was made partly on the basis of size and partly on the basis of appearance. A very loose head, with leaves appearing inside, was classed as a second, regardless of size.

There were some losses from wire-worm injury on some plots, and, in order to eliminate this, records were taken as for a perfect stand.

The differences in growth made by the plants in the various plots is shown in table 11, which gives the average weight of all marketable heads. Table 12 shows the number of marketable heads of each grade.

While the results of one year's work are never conclusive, some points were brought out which have value.

1. Manure alone in the amounts used here does not furnish enough of the proper plant-food to insure a successful crop of cauliflower. Where it is supplemented with 1000 pounds per acre of 4-8-4, together with a side dressing of Nitrate of Soda, satisfactory results were obtained.

2. Cauliflower will pay for heavy fertilizing. Where 1000 pounds per acre of a 4-8-4 was applied the harvest was 2096 firsts and 3212 seconds per acre. With 1500 pounds 4-8-4, 3004 firsts and 2474 seconds were obtained. With 2000 pounds 4-8-4, 3507 firsts and 3059 seconds were harvested.

3. Acid Phosphate alone will not produce a profitable crop. Where two applications of Nitrate of Soda, each at the rate of 150 pounds per acre were applied the yield was much higher than with Acid Phosphate alone, but it was much lower than where a complete fertilizer was used.

4. Side dressings with Nitrate of Soda proved very profitable in connection with a complete fertilizer. One thousand pounds per acre of a 4-8-4 produced 2096 firsts and 3212 seconds. The same amount of fertilizer with a side dressing of Nitrate of Soda at the rate of 150 pounds per acre gave 2254 firsts and 3095 seconds. The plot that received 1000 pounds 4-8-4 and two side dressings of Nitrate of Soda produced 3658 firsts and 3342 seconds, giving the highest yield in the series. The average weight of marketable heads was 2 pounds 8 ounces, only one ounce less than the average weight in the plot that received 2000 pounds 4-8-4 per acre.

5. Where a moderate amount of fertilizer is used it is more profitable to apply part before planting and the balance as a side dressing.

TABLE 20

Average Weight of Marketable Cauliflower Heads in Fertilizer Experiment

Plot	TREATMENT	Series A Average Weight		Series B Average Weight		Average Average Weight	
		pounds	*ounces*	*pounds*	*ounces*	*pounds*	*ounces*
21	Check—No fertilizer	1	14	1	12	1	13
22	10 T. Manure	1	15	1	15	1	15
23	20 T. Manure	2	..	1	10	1	13
24	10 T. Manure, 1000 lbs. 4-8-4, 150 lbs. Nitrate of Soda	2	3	2	8	2	5
25	1000 lbs. 4-8-4	1	15	2	4	2	2
26	1500 lbs. 4-8-4	2	3	2	9	2	6
27	2000 lbs. 4-8-4	2	8	2	10	2	9
28	Check—No fertilizer	1	15	1	15	1	15
29	1000 lbs. 4-8-4, at planting, 500 lbs. 4-8-4 3 weeks later	2	5	2	7	2	6
30	1000 lbs. 4-8-4, 150 lbs. Nitrate of Soda	2	6	2	6	2	6
31	1000 lbs. 4-8-4, 300 lbs. Nitrate of Soda	2	10	2	6	2	8
32	1000 lbs. Acid Phosphate	2	..	1	12	1	14
33	1000 lbs. Acid Phosphate, 300 lbs. Nitrate of Soda	2	1	2	1	2	1
34	700 lbs. Bone Meal	1	12	1	14	1	13
35	Check—No fertilizer	1	.2	2	..	1	14

TABLE 21

Acre Yields of Cauliflower in Fertilizer Experiment

Plot	TREATMENT	Series A		Series B		Average	
		Number per Acre		Number per Acre		Number per Acre	
		Firsts	Seconds	Firsts	Seconds	Firsts	Seconds
21	Check—No fertilizer	396	4488	512	4480	454	4484
22	10 T. Manure	780	4030	1920	2560	1350	3295
23	20 T. Manure	1188	3387	1152	4736	1170	4062
24	10 T. Manure, 1000 lbs. 4-8-4, 150 lbs. Nitrate of Soda	2904	3036	4480	2944	3692	2990
25	1000 lbs. 4-8-4	1287	2860	2904	3564	2096	3212
26	1500 lbs. 4-8-4	2312	2176	3696	2772	3004	2474
27	2000 lbs. 4-8-4	2604	3472	4410	2646	3507	3059
28	Check—No fertilizer	1560	2730	1664	3328	1612	3029
29	1000 lbs. 4-8-4, at planting, 500 lbs. 4-8-4 3 weeks later	3640	3770	3216	3484	3428	3627
30	1000 lbs. 4-8-4, 150 lbs. Nitrate of Soda	2898	3144	1610	3045	2254	3095
31	1000 lbs. 4-8-4, 300 lbs. Nitrate of Soda	4235	2783	3120	3900	3678	3342
32	1000 lbs. Acid Phosphate	1632	4488	1768	5032	1700	4760
33	1000 lbs. Acid Phosphate, 300 lbs. Nitrate of Soda	2860	2730	2340	3900	2600	3315
34	700 lbs. Bone Meal	1120	3220	2432	4608	1776	3914
35	Check—No fertilizer	512	4480	2646	3402	1579	3941

Experiment 3—Variety Study with Cauliflower

Sixteen different strains from 6 varieties of cauliflower were grown at the North Jersey Experimental Plots in a variety comparison. The seed was sown in flats in the greenhouse at the College Farm March 16, transplanted into flats to stand 2 by 2 inches March 27, 28, and planted in 3 by 3 by 3-inch veneer bands April 13. On April 23 the plants were moved to coldframes for hardening. They were set in the field May 3, 24 inches apart in 30-inch rows. The field had previously been manured at the rate of 10 tons per acre, and fertilized with 1,000 pounds 4-8-4. The crop received 2 side dressings of nitrate of soda at the rate of 150 pounds per acre. Twenty-two plants in a row made up a plot and the plots were duplicated.

The crop was harvested at intervals of three or four days from June 14 to July 5. It was blanched by breaking the large outer leaves over the heads. The heads were cut just below the lowest leaves and the weight of heads with the leaves taken. A summary of the records taken is given in table 22. The 3 varieties most widely grown are Snowball, Erfurt and Dry Weather. A comparison of the behavior of the 3 varieties is shown below.

VARIETY	No. of Strain	Average Weight	Yield per Acre	
			Firsts	Seconds
Erfurt	4	2 lbs. 7 oz.	5795	1974
Snowball	6	2 lbs. 6 oz.	5491	4641
Dry Weather	3	3 lbs.	3781	1386

From the summary it appears that Erfurt was the best and Dry Weather the poorest of these varieties, but when the different strains in each variety are examined some striking variations can be seen. Catskill Snowball, from Alex. Forbes & Co., produced heads that averaged 2 pounds 11 ounces, while Early Snowball, from C. C. Morse & Co., averaged 2 pounds. Early Snowball, from Forbes, yielded 4,427 firsts, and Catskill Snowball, from Forbes, yielded 6,707 firsts. The 3 best strains of cauliflower in the test were No. 5, Catskill Snowball, Forbes; No. 12, Extra Early Dwarf Erfurt, Hartman; No. 4, Selected Snowball, Eberle.

TABLE 22

Variety Test of Cauliflower

Plot	VARIETY	Seedsman	Acre Yield		Wt. per Head	
			Firsts	Seconds	*lbs.*	*ozs.*
1	Early Snowball	Morse	4693	2970	2	..
2	Early Snowball	Burpee	5247	2871	2	6
3	Early Snowball	Forbes	4435	2574	2	7
4	Selected Snowball	Eberle	6138	1723	2	7
5	Catskill Snowball	Forbes	6712	1406	2	11
6	E. E. Dwarf Erfurt.....	Burpee	5346	1780	2	11
7	E. E. Dwarf Erfurt.....	Forbes	5683	1406	2	8
8	E. E. Dwarf Erfurt.....	Morse	5584	2931	2	3
9	Dry Weather	Burpee	5148	1386	3	..
10	Dry Weather	Forbes	2931	1703	3	1
11	Dry Weather	Morse	3287	1069	2	14
12	E. Dwarf Erfurt.......	Hartman	6534	1782	2	8
13	Copenhagen Snowball ..	Hartman	5742	2376	2	4
14	Fordhook	Burpee	4158	2693	2	5
15	Special G. H.	U. S. D. A.	5900	2614	2	2
16	Bellingham	U. S. D. A.	594	396	1	13

Experiment 4—Plant-Food Studies with Lettuce

Records were taken of the yield of lettuce on the plots in this experiment, but are not published, because the crop failed to make satisfactory growth owing to the dry weather.

Experiment 5—Variety Study of Lettuce

Spring Crop

The soil on which the spring lettuce varieties were tested received about 10 tons of manure and 1,000 pounds 4-8-4 fertilizer per acre. The lettuce was also given a top dressing of 150 pounds of nitrate of soda per acre. Seed was sown April 19 in rows 14 inches apart, and later thinned, the plants being left 14 inches apart in the row. Each variety had 2 rows 50 feet long. Very little trouble is experienced with extra early spring lettuce; the late spring lettuce, which matures the last part of June, is the crop which causes trouble, so seed was sown for this crop. Twenty strains of lettuce from 10 different varieties were tested. The results of the test are shown in table 23.

TABLE 23

Variety Test with Spring Lettuce

Plot	VARIETY	Seedsman	Stock No.	Marketable Heads			Average Weight		
				Series A	Series B	Average	Series A	Series B	Average
				per cent	per cent	per cent	ozs.	ozs.	ozs.
1	Black Seed Big Boston	Morse	21040	70	20	48	9	7	8
2	Black Seed Big Boston	Eberle	5041	76	29	53	9	7	8
3	Black Seed Big Boston	Abbott & Cobb	33	64	40	52	9	7	8
4	Black Seed Big Boston	Ferdinand	5182	58	57	58	8	8	8
5	Salamander	Morse	9061	26	64	45	8	8	8
6	Salamander	Eberle	604	74	90	82	7	9	8
7	Salamander	Fottler-Fiske Rawson	3555	76	75	76	8	8	8
8	Salamander	Forbes	2382	66	55	61	7	8	8
9	Iceberg	Morse	2149	..	..	..	..	..	..
10	Cal. Cream Butter	Morse	21100	53	45	49	8	9	9
11	Deacon	Morse	7073	2	..	1	8	..	8
12	New York	Morse	22012	..	..	..	..	..	..
13	Drumhead	Morse	2212	..	..	..	..	..	..
14	Black Seed Tennis Ball	Fottler-Fiske Rawson	40	40	9	25	7	5	6
15	Big Boston	Fottler-Fiske Rawson	30	47	58	53	8	5	7
16	Big Boston	Abbott & Cobb	202	23	42	32	7	9	8
17	Big Boston	Kroemer	111	20	80	50	6	8	7
18	Unrivalled	Kroemer	117	32	73	53	5	7	6
19	B. S. Unrivalled	Jos. Harris	285	45	63	54	6	10	8
20	B. S. Big Boston	Forbes	226/4	11	80	46	5	9	7

The varieties of the butter-head type, which are most commonly grown in the spring, are Big Boston (White-Seeded), Black-Seeded Big Boston and Salamander. For an extra early spring crop Big Boston, or the closely related Green-Leaved Big Boston (Unrivalled), gives satisfactory results, because it is usually harvested before hot weather occurs. The Black-Seeded Big Boston is more resistant to heat than the white-seeded. For hot weather conditions Salamander is the best variety. A summary of the comparative standing of these varieties is as follows:

VARIETY	Number of Strains	Marketable Heads
		per cent
Salamander	4	66
B. S. Big Boston	5	57
Big Boston	3	45

Considerable variation was noticed among the different strains of Salamander. The three best strains in the test were No. 6, F. K. Eberle; No. 7, Fottler-Fiske-Rawson; No. 8, A. Forbes & Co.

The crisp-head types of lettuce are being grown more each year in this state to supply a demand which the California lettuce has developed. For a summer crop the Iceberg No. 9 proved more satisfactory than the Los Angeles (New York or Wonderful), often miscalled California Iceberg.

Fall Crop

Thirty-eight strains of lettuce were grown in the variety test for the fall crop. The test was made on the same plot that had been used for the variety test in the spring. It was plowed July 9 and harrowed. Sixteen hundred pounds per acre of a 4-8-4 was applied July 24 and harrowed in. The seed was sown July 30 in 14-inch rows, and the plants were thinned later to stand 14 inches apart. Each variety had two rows 31 feet long. The results of the test are shown in table 24.

Big Boston is the most widely used variety for fall culture, though the Green-Leaved Big Boston (Unrivalled) is also extensively used. Of the crisp-head varieties New York (Los Angeles or Wonderful) is becoming very popular. A summary of these varieties is as follows:

VARIETY	No. of Strains	Average Weight	Average Yield per A. Doz. Heads
		oz.	
New York	5	12	1736
Big Boston	12	7	1259
Big Boston Green-Leaved	8	6½	1052

TABLE 24

Variety Test of Fall Lettuce

Plot	VARIETY	Seedsman	Seed Obtained By	Stand	White Heart	Wt. per Head	Doz. Heads per A.
					per cent	*ozs.*	
1	B.S. Big Boston	C. C. Morse & Co.	N. J. Experiment Station	Good	15	6	1151
2	Iceberg	C. C. Morse & Co.	N. J. Experiment Station	Good	12	9	1307
3	Big Boston	Fottler-Fiske Rawson	N. J. Experiment Station	Fair	10	7	1805
4	Big Boston	Abbott & Cobb	N. J. Experiment Station	Fair	6	7½	1867
5	Big Boston	Kroemer	N. J. Experiment Station	Fair	9	8	1370
6	Unrivalled or Kroemer's New	Wm. Kroemer	N. J. Experiment Station	Poor	5	7	1401
7	B.S. Unrivalled	Jos. Harris	N. J. Experiment Station	Good	5	6½	1649
8	B.S. Big Boston	Forbes	N. J. Experiment Station	Good	2	7	1182
9	Big Boston Special	Abbott & Cobb	N. J. Experiment Station	Good	8	7½	1401
10	Big Boston White Special	Abbott & Cobb	N. J. Experiment Station	Poor	7	9	529
11	Unrivalled	Forbes	N. J. Experiment Station	Good	10	6	1245
12	Big Boston	Forbes	N. J. Experiment Station	Fair	9	7	1120
13	Big Boston	Simon	N. J. Experiment Station	Fair	8	6	1058
14	Cabbage Head	Simon	N. J. Experiment Station	Good	5	5	1058
15	New York	C. C. Morse & Co.	N. J. Experiment Station	Good	15	11½	1867
16	Big Boston	C. C. Morse & Co.	N. J. Experiment Station	Fair	11	6	1482
17	Impr. Big. Boston	Eberle	G. W. Haase, River Edge	Good	12	6½	1401
18	New York	Eberle	G. W. Haase, River Edge	Good	10	13½	1836
19	Eberle's Perfection	Eberle	G. W. Haase, River Edge	Good	17	7	995
20	B. S. Big Boston	Stumpp	John Clausen, Hackensack	....	....	....	....
21	Impr. Big Boston	Forbes	John Clausen, Hackensack	....	....	....	....
22	Hopkins' Big Boston	Simon	R. W. DeBaun, Pine Brook	Good	5	6	2116
23	New York	Henderson	R. W. DeBaun, Pine Brook	Good	16	12	2085
24	Big Boston	Webber	Robert Axt, Brookdale	Fair	5	6	1345
25	Big Boston	Forbes	Robert Axt, Brookdale	Fair	16	7	747

TABLE 24—Continued

Variety Test of Fall Lettuce

Plot	VARIETY	Seedsman	Seed Obtained By	Stand	White Heart	Wt. per Head	Doz. Heads per A.
					per cent	*ozs.*	
26	Hopkins' Big Boston	Simon	Robert Axt, Brookdale	Good	14	7½	1432
27	Green-Leaved Big Boston	Stumpp & Walter	J. Englebrecht, Athenia	Fair	8	6	1494
28	New York	Henderson	J. Englebrecht, Athenia	Good	11	12½	1805
29	Big Boston	Henderson	J. Englebrecht, Athenia	Poor	6	7	498
30	Big Boston	Kroemer	Henniger & Bender, Richfield	Fair	16	7	1182
31	Big Boston Special	Eberle	Henniger & Bender, Richfield	Fair	14	6½	1245
32	Kroemer's New	Wm. Kroemer	Possenreide & Damm, Richfield	Poor	9	5½	684
33	Big Boston Special	Wm. Kroemer	J. Ollwerther, Richfield	Fair	16	6	653
34	Iceberg	Wm. Kroemer	W. H. Englebrecht, Richfield	Good	16	8	280
35	Simpson	Webber	W. H. Englebrecht, Richfield	Poor	15	12½	342
36	New York	Eberle	W. H. Englebrecht, Richfield	Good	13	11	1089
37	Green-Leaved Big Boston	Stumpp & Walter	Henry Clausen, Little Ferry	Fair	15	4½	430
38	Big Boston	Henderson	F. Brandenberg, No. Arlington	Fair	22	8	467

The three leading strains of each of these varieties is given below.

Plot		Seedsman	Av. Weight	Yield per Acre
			oz.	*Doz. Heads*
22	Big Boston	I. N. Simon	6	2116
5	Big Boston	W. Kroemer	8	1870
4	Big Boston	Abbott & Cobb	7½	1864
2	New York	Henderson	12	2085
15	New York	Morse	11½	1867
18	New York	Eberle	13½	1836
27	*Green-Leaved Big Boston*	*Stumpp & Walter*	6	1494
6	Unrivalled	Kroemer	7	1401
11	Unrivalled	Forbes	6	1245

One cause of heavy losses to the lettuce crop is a condition which, for the want of a better name, can be designated as "White Heart." This attacks the plants at all stages of development. If plants are not attacked until they are nearly mature, it results in a head not quite so hard as normal, and a bleaching of some of the leaves that are exposed to the light. Plants affected while very young are stunted, never form a head, but develop a bunch of narrow leaves showing little or no green. There is often a difference in the amount of this condition occurring in different varieties grown under the same conditions. The same lot of seed sown at different times will show varying amounts of the disease. The percentage of plants in each of the varieties in the variety test showing this condition is shown in table 24.

Report of the Department of Animal Husbandry

Frank G. Helyar

The new Dairy and Animal Husbandry building, for the construction of which the 1922 Legislature appropriated $150,000, has been practically completed during the year, and the equipment, for which the 1923 Legislature appropriated $50,000, selected and purchased. The new building includes laboratories for the study of nutrition problems, which will be a most valuable adjunct to the facilities on the farm. The head of this department has spent much of his time during the year with the details of the completion and equipping of the building.

THE HERD

There are 149 swine in the herd. These are divided as follows:

	Durocs	Yorkshires	Hampshires
Herd Boars	3	..	..
Brood Sows	19	2	1
Young Stock	115	8	..
Fat Barrows	1	..	3

The Hampshires were purchased last November from Roy Patrick, of Quinton, New Jersey, and the two Yorkshire sows from the Ohio State University in January.

Health of the Herd

As far as could be ascertained definitely there was but one case of cholera in the herd during the season of 1923. A young sow died following an illness of 2 weeks, 43 days after double treatment. The outbreak of hemorrhagic septicemia during the spring (noted in report of 1923) subsided after vaccination of the herd with hemorrhagic septicemia bacterin, and did not appear until the spring of 1924, when the young pigs farrowed in February and March were attacked. Vaccination with bacterin again controlled the outbreak. The first lot of young pigs were double treated for hog cholera on May 25, 1924. Out of this lot 9 animals died from the cholera. The second lot, consisting of 39 animals, was inoculated June 19, 1924, and out of these 3 animals died. The disease appeared in a very virulent form and spread from the young animals to older animals that had been double treated in previous years and which were supposed to have been immune. It is impossible to state definitely

the reason for the outbreak, but the most plausible reason seems to lie in the fact that as a result of the cold, wet spring, and, in some animals, the presence of round worms, the animals attacked had lost enough resistance to enable the infection to take place. As has been stated in other reports, the soil in the swine ranges needs drainage badly, and it is felt that without good soil drainage in the pastures frequent outbreaks of disease must be expected.

RESEARCH WORK

During the summer of 1923 studies of the variations of weights of pigs at birth and during development were continued. The work is being carried on again during the summer of 1924, and data will be presented next year for the 3 years.

A study of the influence of the simultaneous method of inoculation against hog cholera on the growth of the animals inoculated was made in 1923. On July 18, 1923, 53 pigs, whose weights had been taken weekly since birth were given the double treatment after normal temperatures had been ascertained. The pigs were weighed each week after treatment and temperatures taken every other day for a period of 14 days. Forty-six animals showed a decided reaction to the inoculation, the temperature rising from 2 to 5 degrees above normal some time between the fourth and sixth days, then falling in a day or two to normal again. None showed any appreciable rise in temperature after the sixth day except 2, one of which died suddenly on August 3 after developing a fever on July 30, 12 days after treatment, and the other, which died on August 30, 43 days after treatment. The first of these pigs showed no signs of cholera on post mortem. The second, however, presented a typical case of hog cholera. Both of these animals had developed a typical reaction on the sixth day after treatment, and had, apparently, recovered, as their temperatures fell to normal like the others.

A study of the weights for the 4 weeks after inoculation shows that the average daily gain for the period for 49 pigs was 0.7 pounds. Nine pigs made the average gain during the period, 19 pigs made more than the average, and 21 made less. Table 1 shows the distribution.

The average of 0.7 pounds is only a fair gain, and would seem to indicate that the inoculation had lessened the daily gain. Two other factors must be taken into account, however. One is the hot weather of the period. Experience at the station has shown that the daily averages at this time of the year are lower than in cooler weather. The other factor is the animals themselves. Not all animals possess the same growth factor. Table 2 shows the weaning weights (at 8 weeks of age) of the 49 animals included in table 1.

TABLE 1
Average Daily Gain in Weights

Gain lbs.	No. of Pigs
1.4—1.5	1
1.3—1.4	2
1.2—1.3	2
1.1—1.2	4
1.0—1.1	2
.9—1.0	2
.8— .9	6
.7— .8	9
.6— .7	3
.5— .6	7
.4— .5	3
.3— .4	5
.2— .3	2
.1— .2	1
	—
	Total..... *49

*One pig was taken out because of injury and three were not considered because of losses due to castration.

TABLE 2
Weaning Weights and Average Daily Gain of Pigs

Average Daily Gain	Number of Animals	Total Weaning Weight	Total Weaning Weight for Those Making Daily Gain	Average Weaning Weight per Pig
lbs.		*lbs.*		*lbs.*
1.4—1.5	1	19.2	Average	19.2
1.3—1.4	2	64	or	32.0
1.2—1.3	2	66	Above	33
1.1—1.2	4	116	*lbs.*	29
1.0—1.1	2	61		30.5
.9—1.0	2	52		26.0
.8— .9	6	170.4		28.4
.7— .8	9	276.1		30.6
	—28	——	824.7	
.6— .7	3	79.6		26.5
.5— .6	7	231.5	Less than	33.07
.4— .5	3	68.5	Average	22.8
.3— .4	5	103.5		20.7
.2— .3	2	48.6		24.3
.1— .2	1	16.7	548.4	16.7
	—21	——	——	
	49		1373.1	

Average weaning weight for 49 pigs .... 28.02 lbs.
Average weaning weight for 28 pigs making daily gain average or above .... 29.45 lbs.
Average weaning weight for 21 pigs making daily gain less than average .... 26.1 lbs.

From table 2 it will be seen that the pigs with the higher weaning weights averaged to gain more per day than those with lower weaning weights. The group of 28 pigs with the higher weaning weights made an average daily gain of 0.91 pounds, which, in July and August, is very satisfactory. To sum up, the experience of this year would indicate that double treatment in itself does not result in lower growth rates for the period following the inoculation. This work will be continued from year to year.

HOGGING DOWN CORN TRIAL

A question asked by many farmers in New Jersey is "Does hogging down corn pay?" The department is collecting data to answer the question from a series of trials in which careful record is kept of all foods consumed and labor used. The first trial was made in the season of 1923. Lot X, consisting of 4.76 acres, was planted to corn in the drill. The land, which had been been in mixed grass and clover sod for 4 years, was plowed in the fall of 1922 and left until the following May, when it was fitted and planted with the following amounts of fertilizer applied per acre; nitrate soda, 150 pounds; acid phosphate, 300 pounds, and muriate of potash, 25 pounds. Reid's Yellow Dent was used for seed. When the corn had matured thoroughly an acre of even stand was measured off at one end of the piece, one-half of this was fenced in, and 20 pigs weighing 2,415 pounds were turned in November 9, 1923. A self-feeder supplied with standard wheat middlings and 60 per cent digester tankage and water supply was placed in the lot. The other half acre was cut, the corn husked and weighed and the corn fed to 20 pigs weighing 2,195 pounds in a dry lot also furnished with a self-feeder and water as was the first lot. The pigs hogging down the corn finished the half acre November 27, when both lots were weighed.

Inasmuch as the pigs in the field performed this labor, the above amount of $27.20 was deducted from the market price of the corn they consumed.

From the above it will be seen that while the pigs in both lots made the same average daily gain, the pigs in the corn lot consumed less middlings and tankage and saved labor, the most expensive element in farming to-day.

Three new projects are in progress this season, namely, a study of protein selection by swine, a study of the effect of gelatin on pig growth and a comparison of fish meal and tankage for swine.

TABLE 3

Summary Results of Hogging Down Corn Trials

	Corn Lot	Dry Lot
	lbs.	*lbs.*
Initial weight of pigs	2415	2195
Final weight of pigs	2915	2757
Total gain of pigs	500	562
Average daily gain per pig	1.56	1.56
Food Consumed		
Corn Shelled*	2891.2	2891.2
Standard Wheat Middlings	20.00	75.0
60 per cent Digester Tankage	50.00	100.00
Cost of Food Consumed		
	Corn Lot	Dry Lot
Corn shelled 90c per bu.†	$19.27	$46.47
Middlings $34.80 per ton	.348	1.30
Tankage $75.00 per ton	1.88	3.75
Total cost	$21.498	$51.52
Cost 1-lb. gain	$0.0429	$0.0916

*As the stand of corn was very even it is estimated that the yield of corn on the half acre hogged down was at least equal to the half acre cut, husked and weighed.

†The corn fed to the pigs in the dry lot was charged at the prevailing price at the time in New Brunswick, namely, 90 cents per bushel. The price charged for the corn in the half acre hogged down was figured at the same *rate minus the cost of harvesting the corn fed to the pigs in the dry lot.* The cost of this operation was distributed as follows:

Cutting and shocking 24 hours @ 40c	$9.60
Husking 28 hours @ 40c	11.20
Hauling 4 hours @ $1.60	6.40
Total	$27.20

Report of the Department of Poultry Husbandry

WILLARD C. THOMPSON

One of the basic functions of the department is to develop and carry through an annual program of work which, in so far as its office in the Agricultural Experiment Station is concerned, might be divided into two main endeavors. In the first instance, there is the definite objective of undertaking the performance of certain important pieces of research or experimentation, the exact nature of which must always be determined by the trend of developments in the whole field of the science of poultry husbandry, the imminent needs of the industry in New Jersey, the relative necessities of new lines of work and the limitations of the equipment and personnel. In the second place, there is the great responsibility of rendering educational and advisory service to those men and women and boys and girls who are engaged in the practice of poultry culture within the confines of the state. The work of this department of the station during the past fiscal year has been advancing along both these lines. This foreword aims to declare a general policy which has been made known to the industry at large and which has helped to clarify all minds as to the nature of work being done by the department.

ACKNOWLEDGMENTS

The experimental projects accomplished during the past year have been made possible only through the loyal, faithful and efficient work of the various members of the staff of the department throughout the entire year. The poultry husbandman desires to acknowledge this aid and assistance with an expression of keenest appreciation.

PUBLICATIONS

As has been the custom in recent years, 12 numbers of the Hints to Poultrymen series, one on the first of each month, have been issued, covering in order the following subjects: Egg Prices and Cold Storage Holdings: New Jersey's Poultry Exhibitions; Organizing a Poultry Plant; Some Lessons from Production Records; Vitamins and Their Relations to Poultry Diseases; Report of Egg-Laying Contests for 1923; Production, Monthly Costs and Receipts on New Jersey

Poultry Plants; Getting Maximum Results from the Incubator; Diseases of Baby Chicks; Why Chicks Die; The New Jersey Multiple Brooder House; and A Description of the Method for Collecting Blood Samples from Breeding Stock to be Tested for "Carriers" of Bacillary White Diarrhea.

Another service circular in the "every page a picture story" series has been offered, entitled "Care and Management of Baby Chicks." Thirty illustrations, accompanied by 30 concentrated paragraphs, tell the complete story of the baby-chick season.

A research bulletin on "The Prediction of Egg Records" has included the first report in a series of investigations being conducted by Prof. G. W. Hervey.

A popular revision of a former bulletin has been published by Waller and Thompson under the title of "Poultry Farming in New Jersey" as circular 153.

The department has offered two papers in the Journal Series, one on "The Relation of External Body Characters to Annual Production in Barred Plymouth Rocks" by Hervey, with H. R. Lewis assisting, and the other on "A Note on the Inheritance of Egg Production in the Leghorn Fowl," by Hervey, bearing numbers 142 and 171, respectively. Many technical papers are planned for the ensuing year, as the research work develops and reaches reporting stage.

It is felt that in every case in which there is experimental evidence of new truth the poultry scientists and practical poultry operators should be quickly and widely advised, and, therefore, the department is building a policy of conservative, constructive publicity which it is hoped may definitely contribute to the general fund of knowledge by which any industry, such as poultry production, may be improved.

SERVICE PROGRAM

In the course of the last fiscal year slightly over 12,000 letters have been written by various members of the staff to poultry men and women in the state, in addition to several hundred written to out-of-state residents who have asked the courtesy of assistance in difficult poultry problems. Perhaps the most notable change in the correspondence over other recent years has been the increase in letters concerning poultry diseases and parasites, this being due, no doubt, to the widespread knowledge among poultry raisers that the division of poultry pathology had been placed in charge of an experienced authority on the subject. The problems concerned with poultry breeding and with the propagation of the flocks have caused many letters of inquiry to be addressed to the department. Telephone calls, as well as personal calls at the office, have presented many other poultry problems for answer and discussion. All members of the staff are engaged from time to time with different parts of the general service program. It might be well to recall that the poultry raisers of the state have been receiving advice and assistance in the manage-

ment of their poultry flocks from members of the staff during the year through the following means or agencies (after each item the approximate number of poultry keepers reached by that agency is indicated):

By letters in answer to inquiries	10,500
By letters originated in department office	1,500
By telephone calls	700
By visits of poultrymen to offices	180
By visits of staff members to farms	70
By addresses given before public meetings	8,000

To this number of approximately 20,950 people, should be added the large number of persons reached through the distribution of pamphlets and literature. It is felt that, in so far as due justice to research and educational responsibilities has permitted, the service program of the department has been well carried out. The rather complete organization of the poultry keepers of New Jersey into local and state groups has greatly facilitated the spreading of new and timely poultry information among interested parties throughout the length and breadth of the state. Various members of the staff have served the New Jersey State Poultry Association in its educational and research development program, in this way strengthening the whole program of work for poultry development in New Jersey.

NEW JERSEY EGG-LAYING CONTESTS

During the past year several changes have been made in the policy of egg-laying contest management in New Jersey. The progress of this branch might best be discussed under the two sub-headings of (a) the Bergen County project, and (b) the Vineland project. Inasmuch as the separate reports are or will be issued concerning details of work at these stations, only matters of general report and policy will be offered in this place.

On November 1, 1923, by general consent of all parties concerned, the type of contest operated at Westwood, N. J., in Bergen County, was changed. That contest had been operating for 3 years as a 3-year type of egg-laying trial. It was considered that further usage of this type of contest would be impracticable and unsuited to the best purposes and needs of the poultry breeders of the community and state. In its place a straight 1-year pullet contest was installed. Under the new plan pullets were received from 100 flock owners in groups of 20 birds each. These 2,000 pullets have been trapnested and recorded during the balance of the year, and will continue through October 31, 1924, the end of the contest year. Replacements for fowls dying during the year have been made by the owners. Certificates of merit have been issued to high hens and high pens each month. The prompt filling of all available pens for this contest was ample proof of the popularity of the change. It was felt that by so

changing the type of trial at Bergen County the contest would better serve the poultry breeders who might wish to make use of it in the building up of their pedigreed, trapnested stock. As this report is being prepared the possible entries for the next succeeding contest at Bergen County are almost completely booked. The department feels that more than ever before are the New Jersey contests filling a very necessary part in the program of the progressive poultry breeders of the state, through making possible for them officially directed institutions where they may have their choicest pullets carefully and accurately trapnested and recorded. In so far as the contests fit into such a place in the general scheme of poultry development are they warranted in continued and well-supported existence.

On November 1, 1923, the first year of the Third Vineland International Egg-Laying and Breeding Contest was commenced. Each of the 100 pens was cut down to the 12 best-record individuals, judged according to their first or pullet year record as well as appearance and condition. These yearling hens have been under the trapnest for the 8 months since November 1, and will remain there until October 31, as is customary. During this past spring pedigreed chicks have been hatched from these selected breeding hens, mated to pedigreed cockerels of the owner's choosing. The percentage of hatch at the Vineland contest has been exceedingly gratifying, often reaching a figure in advance of 65, this of all eggs set and under pedigreeing conditions. The machine installed and used was a 6,000-egg, double-deck Wishbone Mammoth. Surplus cockerels from the chick flocks reared at the Vineland contest are being made available at reasonable figure to owners and other interested poultry breeders. From the young stock reared this summer the necessary 20 pullets for each of the 100 pens will be selected on November 1, 1924. As a type of egg-laying trial the 3-year plan is hardly fulfilling the essential requirements in New Jersey, and is proving a most expensive type to operate under present-day labor and operation-cost figures. A most thorough test of the scheme has been made in Vineland. No definite conclusions will be drawn before the close of another year, but at the close of the present Vineland contest the question will be referred to the poultrymen of the state for serious consideration. It is urgently hoped that the New Jersey contests may always render only helpful service to the industry.

Both contests continue to mount up vast stores of facts and figures to be analyzed and studied by the research staff. The records of these contests have furnished the valuable material used in the study of the prediction of egg records, later reported in this writing.

On June 30, 1924, the average percentage of production being secured at the Bergen County Egg-Laying Contest (present correct name) was 50.09, a remarkably high figure for midsummer, while at Vineland the figure was 52.75, this on yearling hens. Both contest plants are in splendid physical shape. By solving many poultry problems, both contests through their respective foremen are serving the communities in which they are located.

NEW JERSEY POULTRY EXHIBITIONS

One duty imposed upon this department by Chapter 19, Laws of 1923, is the administration of a certain fund of money created by that law for the aiding and developing of healthful competition among poultry breeders of the state, and the staging of suitable exhibitions of purebred poultry. This project has been running for 4 years previously. The rules and regulations under which this money is used by societies or poultry groups for the purposes of the act have been remodeled and brought up to date during the past year. The state-wide poultry show, under the name of the Newark Poultry Show, held from December 11 to 15, 1923, was aided by this fund, as was the fall poultry show held in conjunction with the Trenton Inter-State Fair, both of these exhibitions being considered as reaching wide territories. Local poultry shows in the following counties also participated in this fund: Bergen, Burlington, Cumberland, Gloucester, Mercer, Monmouth, Ocean, Hunterdon, Sussex, Cape May, Middlesex, Passaic and Atlantic. Except for a very small amount used for office administration, all of the $6,000 available was used for the increasing of interest in poultry exhibiting. It was felt that interest in the breeding of better and more purebred, standard poultry was very greatly enlivened through using the fund herein described in the following ways:

1. Making possible increased premiums and awards, thereby drawing larger numbers of exhibitors to said shows.
2. Making possible better and more attractive exhibitions, thereby bringing to increased numbers of people the value of better purebred poultry.
3. Advertising the benefits of the exhibition of good fowls.
4. Assisting in the planning and management of such exhibitions.
5. Advising and aiding in the conducting of the newer shows.
6. Giving publicity to the advantages of the whole scheme.

It is conservatively estimated that in exhibitions held under the benefit of this fund upwards of 16,000 fowls were exhibited, and over 50,000 people saw them during the periods of exhibition. The direct results of such a project are difficult to estimate, but the ultimate value of such work cannot be overestimated.

It is felt that not more than one strong poultry show should be staged in any one year in any one county. New Jersey is tending toward the holding of fewer but better poultry exhibitions, a wise policy which must, ultimately, create shows of greater importance and value.

EXPERIMENTAL POULTRY FARM

During the past year the major experimental projects of the department have been of such nature as to make it possible for the foreman of the research farm to undertake a complete reorganization and rearrangement of the farm. It is felt that the 25-acre farm con-

nected with the department should be devoted entirely to research projects. To make this a practical fact it has been necessary to build many rods of new fences, remodel several hitherto commercial poultry laying-houses, and construct certain new breeding units. In addition a chronic infection of the flock with fowl cholera has made it seem advisable to apply strict quarantine and complete sanitation to the plant during the past spring and present summer. During this period few fowls are being kept on the place. New stock will be secured in the fall, and placed under the trapnest for the ensuing year, after which time the research plant will be in full operation. A new brooder-house will be constructed, in order to make possible better work with the baby-chick end of our program. It is planned that the department shall have one of the finest experimental poultry farms in the country at the completion of the present reorganization.

THE RESEARCH PROGRAM

During the past fiscal year more projects have been started and more results actually secured than in any previous year, a condition which simply indicates the normal, healthy growth and development of the department. The experimental work of the department has been outlined according to a very definite schedule here presented in order that the whole program may be understood:

1. All poultry breeding projects are listed as A, and each project is assigned a number; the final two figures of the year in which it was started complete the designation. In present operation are:
   - A3-16 New Jersey Egg-Laying Contests
   - A4-21 Development of High-Producing Strain of S. C. W. Leghorns
   - A5-21 Analysis of Egg-Production Records
   - A6-21 Relative Influence of Sire and Dam in Breeding and Mating for High Egg Production
   - A7-23 Improvement of Poultry Through Poultry Exhibitions
   - A8-23 Economy and Value of Proved Sires
   - A9-23 Breeding for Factors Essential to Exhibiting of Fowls
   - A10-23 Natural Poultry Life Span
2. All poultry pathology projects are listed as B, as follows:
   - B1-23 The Diagnosis of Poultry Diseases Occurring in New Jersey
   - B2-23 Study of *Heterakis Perspicillum* in Poultry
   - B3-23 Observations on the Occurrence of Oocysts of *Eimeria Avium* in the Cecal Contents of Domesticated Fowls
   - B4-23 Relation of Soil Reaction to Infectious Poultry Disease Organisms
3. All poultry nutrition projects are listed as C, as follows:
   - C1-23 Relation of Vitamin Content of Rations to Health and Productive Capacities of Adult Fowls
   - C2-23 Supplementary Feeds for Adult Fowls
4. All poultry housing and environment studies are listed as F, as follows:
   - F1-23 Modification of Existing Poultry Houses to Provide Optimum Environment During Winter Confinement

During the ensuing year several new projects will be added, and certain of the above completed or rested.

In the following paragraphs definite report is made on certain of these projects as seems fitting at this time. In many cases progress

only can be reported at this time, which is the midst of the poultry-operations year. Unless other mention is made the projects listed above are progressing, but no definite report is considered wise at this time.

A Group—Poultry Breeding

Prediction of Egg-Production Records. The analysis of production records of White Leghorn females has been continued during this past year, main attention being given to the prediction of annual production, in both the first and second laying years, from seasonal records. In all, 1,186 individual weekly records secured in the First Vineland and First Bergen County Egg-Laying Contests have been investigated. The results of many months of tabulation and study in this investigation indicate that:

1. The annual laying cycle of the Leghorn fowl may be divided naturally into 3 equal parts, or periods—November-February (winter), March-June (spring), and July-October (summer-fall), inclusive.

2. Production of the first laying year exceeds that of the second. Greatest decrease in second-year production occurs in the winter period. A decline in production is also noted during the summer-fall period of the second year. Spring production of the second year may be either greater or less than the first spring production.

3. Correlations exist between (a) seasonal and annual production in both the first and second laying years, (b) the respective seasonal production of both years, (c) seasonal production of the first year and total production of the second year, and (d) annual production for both years.

4. Regression of production in one period upon that in another can be represented by either a straight line or a second order parabola. Use of either one, as a function for graduating a set of data for this purpose, must be regarded purely as an interpretation of average regression. In each case investigated, actual production is characterized by pronounced deviations from mean production.

5. Greatest relative variation from mean production, in both the first and second laying years, occurs in the winter period.

6. As mean production rises, absolute and relative variations from mean production decline.

7. Were it not for the variability of production, it would be possible to predict future production, from a brief performance record, with a high degree of accuracy. Environmental conditions are partly responsible for individual variations in production. When the influence of heredity is also considered, variability of production makes the problem of prediction become further complicated. Improvement in the efficiency of prediction may possibly be demonstrated as additional analyses of performance records are made on a large scale, until a point is reached where magnitude of the observations will allow more accurate graphical representation of prediction and minimize the effect of unusual variations. Meanwhile, trapnesting for the entire year must continue to be the only certain method of ascertaining exact production.

8. Prediction of future production by means of straight-line or parabolic equations depicting regression of production in one period upon that in another, may have a practical application in a system of trapnesting during a 4-month period in the first or second laying year for the purpose of selecting females of high prolificacy for retention as breeding stock. Practicability of prediction, however, is confined to the use of such a period as an index of annual production.

9. The winter and summer-fall months are of approximately equal theoretical value as a measure of first-year production, but practical advantages make

the winter period preferable. First-year production is predicted least efficiently from the spring record. Spring production in the second year is more valuable than that of the other seasons as a criterion of second-year production.

10. No great value can be attached to a seasonal record of the first year as an indication of the corresponding seasonal record of the second year or of the entire second-year period.

11. The record of the entire first year measures second-year production more efficiently than any seasonal record of the first year.

A Comparison of Egg-Production Records of Dams and Daughters. The theory that trapnest records of mothers' production bear an insignificant relationship to the production records of their daughters, when pedigreed sires are not considered, has been corroborated by an analysis of the actual performance records secured in New Jersey contests, when first-year records of 848 dams, all White Leghorns, and those of approximately 1,600 daughters were tabulated. P. A. Hayden did the bulk of this computation. Mean production of mothers was 185.7 eggs and of daughters 169.9, with standard deviations of 33.7 and 41.7 eggs, respectively. The 190-egg mark was the point of greatest frequency for mothers, while for daughters it was 20 eggs less. On productions below 160 eggs daughters showed greater frequency; above 160 eggs the dams exceeded in number. No actual correlation was found to exist between production of dams and daughters. Analysis was completed by Hervey.

Relation of External Body Characters to Annual Production in Barred Plymouth Rocks. The data of measurement of the 80 Barred Plymouth Rock hens used in this analysis were originally gathered by Prof. H. R. Lewis, one-time chief of this department, on fowls at the Vineland contest. Hervey has completed the analytical study and statistical expression of the problem. The data, the nature of which is indicated by the terms used in expressing the conclusions, were gathered in July, when farmers normally think of "culling" their poultry flocks. The fowls used were 80 Barred Plymouth Rock pullets finishing out their first laying year. It was found that:

1. There was evidence of a slight and possibly significant correlation between annual production and (a) pigmentation of vent and (b) pigmentation of beak. There was evidence, also, of a higher correlation with spread of pelvic bones.

2. No correlation existed between annual production and (a) the pigmentation factors taken as a whole, (b) pigmentation of shanks, (c) condition of molt, (d) body weight, or (e) quality of pelvic bones.

3. July was too early to cull the birds considered, by use of external body characters, for the purpose of removing those individuals that would not return a high annual production.

Strain Development

The development of the New Jersey Agricultural Experiment Station strain of S. C. White Leghorn fowls is progressing. Such an experiment must progress slowly year by year. A new strain of pullets will be added to the project this coming fall, and all placed under the trapnests.

B Group—Poultry Pathology

This group has constituted a very special and major group of studies during this past year, especially because of the serious and particularly infectious outbreak of disease on the experimental farm. The pathologist has given intimate and toilsome study to the outbreak and has diagnosed the whole situation and instituted proceedings for its complete eradication. The losses have been tremendous, but the scientific information worked out as a result may compensate. At least, they will point out a way of avoiding any such outbreak in the future. No figures are omitted, since it is felt that our poultry farm is in no respects different from many others in the state which have suffered similar outbreaks. At present writing the epidemic has entirely spent itself. In considering the mortality figures for the experimental flocks it should be borne carefully in mind that the specimens include young stock on range which are listed as cockerels and pullets.

The following report has been prepared by F. R. Beaudette, D.V.M., poultry pathologist in charge of general investigations in the field of poultry diseases and parasites:

In the preparation of a report covering the activities of the division of poultry pathology it is necessary to divide the material to be treated into certain subdivisions for the purpose of clarity and simplicity of description. Therefore, it is proposed to discuss the work of the division under the classification of *Diagnosis, Experimental Projects and Educational Service.*

Diagnosis of Poultry Diseases

The diagnostic work consists of the examination of specimens sent to the laboratory from various sources within the State of New Jersey, as well as neighboring commonwealths. A number of fowls have been examined from the station flocks, as well as from the various pens at the New Jersey Egg-Laying Contests. Occasionally post-mortem examinations have been held in the field, while still other cases have been handled by letter, personal visit, telephone or interview.

Laboratory Cases. This classification constitutes the specimens sent in from this and other states exclusive of those received from either of the contest plants or the department farm. The examination of the specimens at the laboratory, where all necessary equipment is at hand and ready for instant use, is by far the most satisfactory method of making a diagnosis. This method is to be encouraged, since it will make possible altogether more effective and valuable reports to the owners of the specimens examined. Table 1 shows the distribution and frequency of diseases found in the specimens sent to the pathology laboratory for examination during the past fiscal year.

TABLE 1

Distribution and Frequency of Diseases in Specimens Examined at Pathology Laboratory

DISEASE	Cock	Cockerel	Hen	Pullet	2 Wk. to 3 Mo.	Under 2 Wk.	Turkey	Goose	Duck	Guinea	Pigeon	Pheasant	Canary	Totals
Fowl Cholera	3	0	27	19	8	0	0	0	0	0	0	0	0	57
Fowl Typhoid	0	0	5	0	2	0	0	0	0	0	0	0	0	7
B. White Diarrhea	0	0	0	0	56	175	0	0	0	0	0	0	0	231
B. pestis caviæ	0	0	0	0	0	0	0	0	0	0	0	0	9	9
Tuberculosis	0	0	6	0	0	0	0	0	0	0	0	0	0	6
Goose Septicæmia	0	0	0	0	0	0	9	4	0	0	0	0	0	13
Botulism	0	0	1	1	0	0	0	0	0	0	0	0	0	2
Favus	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Unidentified infec.	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Ovarian infec. b. w. d.,	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Abscess	0	0	2	0	1	0	0	0	0	0	0	0	0	3
Oedema of wattle	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Bumblefoot	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Pos. Wh. Diar. Test	0	0	3	0	0	0	0	0	0	0	0	0	0	3
Neg. Wh. Diar. Test	0	0	99	0	0	0	0	0	0	0	0	0	0	99
Chicken-pox	0	0	7	11	5	0	0	0	0	0	0	0	0	23
Ocular Roup	0	4	9	10	0	0	1	0	0	0	0	0	0	24
Diphtheritic Roup	2	5	7	5	0	0	1	0	0	0	0	0	0	20
Dipth. Laryngitis	0	1	5	4	0	0	0	0	0	0	0	0	0	10
Bronchitis	0	0	5	7	0	0	0	0	0	0	0	0	0	12
Catarrhal Enteritis	1	1	10	11	0	0	0	0	0	0	0	4	0	27
Foreign bd. in crop	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Impact. Proventriculus,	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Hepatitis	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Poisoning Ptomaine	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Paralysis	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Tumors	0	0	8	0	0	0	0	0	0	0	0	0	0	8
Leukemia	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Nephritis	0	0	2	2	0	0	0	0	0	0	0	0	0	4
Egg Concretions	0	0	3	2	0	0	0	0	0	0	0	0	0	5
Internal Hemorrhage	0	0	2	1	0	0	0	0	0	0	0	0	0	3
Traumatic	0	0	1	1	0	0	0	0	0	0	0	0	0	2
Coccidiosis	0	1	19	61	195	0	0	0	0	2	1	4	0	283
Coccidial roup	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Blackhead	0	0	0	3	21	0	5	0	0	0	1	0	0	30
Trichomonoasis	0	0	3	6	3	0	0	0	0	0	0	0	0	12
A. Perspicillum	2	2	16	67	5	0	0	0	0	0	0	0	0	92
H. Papilossa	0	2	11	55	3	0	0	0	0	0	0	0	0	71
T. Tenuissimum	1	3	8	24	1	0	0	0	0	0	2	0	0	39
S. Trachealis	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Tape worms	0	0	16	41	0	0	0	0	0	0	0	0	0	57
Scaly leg	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Nutritional disease	0	0	3	7	0	0	0	0	0	0	0	0	0	10
Leg weakness	0	0	0	0	3	0	0	0	0	0	0	0	0	3
Visceral gout	0	1	9	2	2	0	0	0	0	0	0	0	0	14
Not diagnosed	1	3	32	5	48	45	0	0	1	0	0	0	0	135
	12	23	329	346	357	220	7	9	5	2	4	8	9	1331

Number of birds examined	1057
Reported with two diseases	110
Reported with three diseases	96
Reported with four diseases	18
Reported with five diseases	40
Reported with six diseases	10
Laboratory cases 1 to 400	

Of all the infectious diseases found bacillary white diarrhea seemed to be by far the most common. A total of 231 cases of this disease were found, and of that number 175 occurred in baby checks under 2 weeks of age, while the remaining cases were found in chicks between 2 weeks of age and 3 months. The diagnosis in all cases was based on the isolation and identification of the specific organism.

In a large number of cases small caseous nodules were found in the lungs of affected chicks. This lesion has been reported before, but seems to have been overlooked by a number of investigators. A number of the specimens affected with white diarrhea between the age of 2 weeks and 3 months showed peculiar lesions that have not been described before. In these instances nodules were found on the heart. In some cases only one large nodule was present, while in other instances a number of smaller nodules were observed. These nodules contained, in most cases, a white semi-fluid material from which a pure culture of *Bacterium Pullorum* could be isolated. A similar culture was also obtained from the heart's blood in these cases. In a very few instances like nodules were found on the serous surface of the breast bone as well as on the gizzard.

Over 100 cultures of *Bacterium Pullorum* have been reserved for future comparative study.

Fowl cholera seemed to be very prevalent. Post-mortem examination of these cases did not reveal anything unusual. Here, again, the diagnosis was based on the isolation and identification of the specific organism, *Pasteurella avium.*

Only 7 cases of fowl typhoid were encountered. It is of interest to note that in two instances this disease was found in chicks under 3 months of age. So far as is known this disease has not been found occurring in young stock heretofore.

Of special interest is the occurrence of a B. *pestis caviæ* infection in 9 canary birds presented for examination. On this occasion no difficulty was experienced in isolating a pure culture of the organism from the heart's blood, even though the specimens had been dead for some time. The common host of this organism is usually found to be a rodent. However, the history of the outbreak in question occurring in a bird store, did not reveal contact with rats, guinea pigs or similar animals. The outbreak caused a loss of 70 out of 200 specimens. This organism is being studied jointly by this laboratory and by Dr. Leo F. Rettger, of Sheffield Scientific School at Yale University.

Only 6 cases of tuberculosis were found, and this appears to be a smaller number than usually found in other heavily populated poultry areas.

The cases of goose septicæmia were found to occur mostly in the large commercial goose-fattening plants in north Jersey. One plant and one breeder of ducks in another section suffered very heavy losses. The outbreak occurring on the commercial plant will be reported upon at the meeting of the American Veterinary Medical Association.

Both cases of Botulism were of type C intoxication, as evidenced by the finding of the larval forms of L. *cæsar* as well as by the symptoms.

An outbreak of disease was investigated in young chicks in which evidence seemed to point to an infection. Specimens were brought from this flock to the laboratory for examination. From the heart's blood of one chick a pure culture was isolated that is here reported as an unidentified infection. The organism has not been postitively identified as yet, although its study will be continued. The organism grows very sparsely under ærobic conditions, and in a fermentation tube displays its affinity for anærobic conditions by acid production in the closed arm of the tube until the end of several days' incubation, when, finally, the whole tube shows acid production.

Only 2 flocks have been tested for "carriers" of bacillary white diarrhea, 1 flock consisting of 60 birds and being found entirely free of the disease, and the other consisting of 42 fowls, in which there were 3 reactors.

It might be well to explain that such diagnoses as catarrhal enteritis, hepatitis, nephritis, paralysis, etc., are only lesion or symptom diagnoses, and, therefore, give no indication as to the actual cause of the condition. Where such diagnoses have been made it was impossible to determine the cause, and hence they must be reported as such.

Intestinal coccidiosis was found to be very prevalent, and most of the cases occurred in chicks between the ages of 2 weeks and 3 months. At this age chicks are most susceptible to the disease, though it will be noted that a number of cases were found affecting older stock. In this instance the disease was the primary cause of the condition, and other factors were not found which could be considered as causative. It was noted, however, that, instead of the cæca being involved, the primary seat of the infestation was the small intestine. The lesions of the disease as it occurs in older stock are by no means specific; a diagnosis can be made only by microscopic examinations of scrapings of the intestinal mucosa.

Blackhead or infectious entero-hepatitis appears to be very prevalent, especially in the common fowl. In turkeys the diagnosis was based entirely on the finding of the specific lesions of the disease, although in some cases suitable for examination the motile forms of the parasite were found. In fowls the diagnosis was sometimes made on the finding of the characteristic lesions, although in some cases, where live birds were presented, the motile forms could be observed on microscopic examination.

A condition diagnosed as "Trichomoniasis" was seen to occur in 12 specimens. In this instance the diagnosis was based on the finding of a parasite in the cæca that could not be differentiated from a *Trichomonas*. It was essential that the microscopic examination be made on a warm stage and with material taken immediately from a killed specimen, as the parasite very soon lost it motility after being taken from the host.

Of the parasitic diseases both the large and small nematode, as well as cestodes, appear to be very common. A very small nematode diagnosed as *Trichosome tenuissimum* was also encountered on a number of occasions. The eggs of this parasite were found in a number of specimens before the worms themselves were found. The parasite itself was first observed in a pigeon, and in this case it occurred in very large numbers. The worm does great damage to the intestine, and may, eventually, prove to be quite an economic problem. It was found that the eggs of this parasite would develop to the infective stage in 4 days when placed at the incubator temperature, thus showing that the infective stage is reached in about half the time that is required for an egg of *H. Papillosa* or *A. Perspicillum*.

Since only one case of gape worms (*Syngamus trachealis*) was found, it may be assumed that this parasite is not very common in New Jersey.

While only 10 cases of nutritional disease were found, it might be supposed that this condition is more common than the figure would indicate, because in several instances the disease accompanied another condition which was the cause of the death.

The diagnosis of leg weakness is intended as specific and refers to a condition which is the result of a deficiency or lack of vitamin D.

In most cases visceral gout was found to accompany another disease, and it was often noted as a secondary condition in nutritional disease. It is of interest further to note that the disease occurred in young chicks.

In 135 specimens a diagnosis was impossible, due largely to the fact that the specimens were badly decomposed, a condition interfering with bacteriological examination. In a few instances only a part of each specimen was sent in, which proved to be insufficient material on which to base a diagnosis.

It will be noted that while only 1,057 birds were examined as laboratory cases, 1,331 diseases are reported as occurring. This is accounted for by the fact that in some cases the specimen showed more than one disease, as indicated at the bottom of table 1.

It is the routine practice to take a culture from the heart's blood of all specimens presented for examination. The blood is streaked across the surface of an agar plate and incubated. If a growth is obtained a transfer is made to an agar slant and the culture marked with a number indicating the case and bird, if more than one bird was included in the case. From the agar slant the culture is inoculated into dextrose, lactose, maltose and saccharose-fermentation tubes. The culture's ability to reduce nitrates, form indol, produce

hydrogen sulfide and ammonia is also tested. From this data the culture can be positively identified, if the disease is fowl cholera, typhoid or white diarrhea. However, occasional cultures are isolated which cannot be identified by these means. It then becomes necessary to study them further, as was the case with *B. pestis caviae.* This procedure will also be necessary to identify the partial anærobe isolated from chicks. After the culture is identified it is filed for future comparative study or reference.

It is also the routine practise to make a microscopic examination of the cecal or intestinal contents for the presence of oocysts or other protozoan forms. Search is also made for the eggs of intestinal nematodes and cestodes.

The 1,057 specimens examined as laboratory cases were sent in by 400 different persons, hence they are considered as 400 cases. The origin of these cases is given in table 2.

TABLE 2

Origin of Laboratory Cases for Poultry Disease Diagnosis

From New Jersey—		From Other States—	
Atlantic County	5	New York	7
Bergen	20	Connecticut	1
Burlington	15	Pennsylvania	5
Camden	13	Virginia	3
Cape May	1		16
Cumberland	26		
Essex	16		
Gloucester	7		
Hudson	4		
Hunterdon	31		
Mercer	25	Total from New Jersey	384
Middlesex	104	Other States	16
Monmouth	24		
Morris	27	Total cases	400
Ocean	11		
Passaic	9		
Salem	2		
Somerset	18		
Sussex	2		
Union	21		
Warren	3		
	384		

Department Farm Cases. Under this heading are considered specimens examined from the flocks on the college farm, including 982 fowls of all ages, and presenting 1,462 conditions diagnosed. See table 3.

Outstanding among the diseases is fowl cholera, of which 506 cases occurred. This outbreak started in the late fall after the young stock was practically matured and transferred to the houses for winter management, and continued practically throughout the winter. In

TABLE 3

Department Farm Cases

DISEASE	Cock	Cockerel	Hen	Pullet	2 Weeks to 3 Months	Under 2 Weeks	Guinea	Pheasant	Total
Fowl Cholera	13	78	316	98	0	0	1	0	506
B. Coli Infection	0	0	0	0	0	7	0	0	7
White Diarrhea	0	0	0	0	1	2	0	0	3
Pseudo-tuberculosis ..	0	0	2	0	0	0	0	0	2
Ovarian infec. b.w.d...	0	0	3	0	0	0	0	0	3
Arthritis (infec.)	1	0	0	0	0	0	0	0	1
Bumblefoot	0	1	1	0	0	0	0	0	1
Oedema of wattle	0	1	1	0	0	0	0	0	2
Abscess	1	0	3	4	0	0	0	0	8
Chicken-pox	0	0	5	1	0	0	0	0	6
Ocular roup	2	7	53	23	0	0	0	0	85
Diphtheritic roup	0	3	25	3	0	0	0	0	31
Nasal roup	0	0	0	1	0	0	0	0	1
Diphtheritic laryngitis,	0	0	26	0	0	0	0	0	26
Bronchitis	0	3	54	1	0	0	0	0	58
Pneumonia	1	4	1	8	0	0	0	0	14
Pendulous crop	0	0	1	0	0	0	0	0	1
Impacted proventr. ...	0	0	0	1	0	0	0	0	1
Catarrhal enteritis ...	2	9	46	77	1	0	0	1	136
Purulent gastritis	0	0	0	1	0	0	0	0	1
Strangulation of gut..	0	0	1	0	0	0	0	0	1
Hepatitis	0	0	2	0	0	0	0	0	2
Nephritis	0	0	1	0	0	0	0	0	1
Egg bound	0	0	2	0	0	0	0	0	2
Egg concretions	0	0	5	2	0	0	0	0	7
Dist. of bursa of Fabricus	0	0	1	0	0	0	0	0	1
Egg in abdomen	0	0	2	0	0	0	0	0	2
Prolapsis	0	0	3	0	0	0	0	0	3
Coccidiosis	0	15	48	24	1	0	0	0	88
Flagellatosis	0	0	2	0	0	0	0	0	2
A. Perspicillum	1	7	21	47	0	0	0	0	76
H. Papilossa	5	34	89	80	0	0	0	1	209
T. Tenuissimum	1	15	18	25	0	0	0	0	59
Tape worms	0	6	6	16	0	0	0	0	28
Nutritional disease ...	0	0	6	2	0	0	0	0	8
Visceral gout	0	1	17	4	0	0	0	0	22
Ascites	0	0	1	0	0	0	0	0	1
Internal hemorrhage...	0	0	2	0	0	0	0	0	2
Tumors	0	0	5	0	0	0	0	0	5
Not diagnosed	1	6	28	11	0	3	1	0	50
	28	189	797	429	3	12	2	2	1462

continued ... sanitary measures which were instituted, th
the mortality almost the same until very late winter. It was n
season, and was always highest during the colder period
terially reduced. at the approach of warm weather the losses
that the disease-producing organism might remain quite
in latent condition for varying lengths of time. In cert
it was noted that fowls which were in every way apparent
would come down with cholera even after having been
absolutely sanitary quarters. In many instances the flo
remain perfectly healthy for a period much longer than th
tion period of the organism, but with the return of envi
conditions such as coldness or excessive dampness the dise
reappear. For certain periods of time no outbreak would o
with little warning whole pens would be swept by it withi
two. Everything possible in a sanitary way was done. It
been concluded that the quickest and most economical
which to eliminate the infection will be to sell the
plant to stand empty for 3 months during ...
tary meas...

From one specimen a type A *Bacterium pullorum* was isolated from the heart's blood.

The finding of 1 case of tuberculosis was of interest. Other cases of the disease might be expected from this pen because of the close confinement, but no others have been encountered thus far.

The remaining diseases listed occurring in the contest are of no special interest, save, perhaps, a considerable number of cases of visceral gout. This again might be expected, because of the close confinement of the fowls. The report shows what might be termed a normal mortality, and no special epidemic.

Vineland Egg-Laying and Breeding Contest Cases. From this branch plant 72 cases were examined, showing 126 pathological conditions. These are listed in table 5.

TABLE 5

Vineland Egg-Laying and Breeding-Contest Cases

Ovarian infection	2	Multiple abscess of intestine	1
Pseudo-tuberculosis	1	Peritonitis	3
Coccidiosis	11	A. Perspicillum	4
Hepatitis	3	T. Tenuissimum	8
Catarrhal enteritis	10	Diphtheritic roup	1
Abscess of ceca	1	Bronchitis	7
Spleenitis	1	Leukemia	2
Tape worms	1	Abscess on leg	1
H. Papillosa	21	Ovarian cyst	1
Ocular roup	2	Inflammation of oviduct	1
Diphtheritic laryngitis	3	Chronic nephritis	3
Abscess of heart	1	Visceral gout	3
Internal hemorrhage	2		
Tumors	8	Total	126
Egg concretions	6		
Prolapsis of oviduct	1	Number of birds examined	72
Ascites of abdominal cavity	2	Reported with two diseases	32
Not diagnosed	9	Reported with three diseases	16
Bact. pullorum B Infect	1	Reported with four diseases	6
Blackhead	1		
Hemorrhagic enteritis	2	Total	126
Abscess of liver	1		
Impaction of large intestine	1	Vineland cases 1 to 72.	

The finding of a case of *Bacterium pullorum* type B infection is of interest, and the organism isolated from this case will be included in a comparative study with several other strains of the organism.

The frequency of diseases of the digestive system, as well as of the reproductive system, might be expected in this class of birds as they are fed for heavy egg production. This is not shown to a great extent in birds from the Bergen contest, probably because those birds have not been under heavy production for so long as have the birds at the Vineland plant.

Cases by Visit. Only 12 cases were handled by visit. On these visits 22 birds were autopsied. The diseases found are listed in table 6.

TABLE 6

Diseases Found in Cases by Visit

	Hen	Turkey	Chicks	Total
A. Perspicillum	5	....	....	5
Bronchitis	2	....	....	2
Botulism	4	....	....	4
Blackhead	....	1	....	1
Coccidiosis	....	....	6	6
Catarrhal enteritis	6	....	....	6
	....	....	....	24

Number of birds examined	22
Reported with two diseases	2
Total	24

Under field conditions it was not possible to make bacteriological examinations. Additional information might have been gained had these specimens been examined in the laboratory.

The visits made were to the following counties:

Middlesex	2
Hudson	1
Burlington	1
Ocean	5
Union	2
Morris	1
	12

Cases Handled by Letter. Four hundred and fifty cases were handled by letter. A large number of these cases were in states other than New Jersey. In general, this is a very unsatisfactory way in which to give help, in that an accurate diagnosis cannot be made in most cases. In most cases the owner was instructed to send in specimens for examination, so that the real cause of the trouble could be determined. However, in few instances the description could be easily made and appropriate measures recommended.

Of the cases handled by letter 338 were from New Jersey, and these are grouped according to counties. A study of table 7 gives a fair index as to the leading counties in the poultry industry.

TABLE 7

Cases Handled by Letter

COUNTIES IN NEW JERSEY		OTHER STATES	
Atlantic	18	New York	32
Bergen	23	Pennsylvania	22
Burlington	14	South Carolina	2
Camden	32	Missouri	3
Cape May	6	New Hampshire	2
Cumberland	39	Virginia	5
Essex	15	West Virginia	2
Gloucester	22	Indiana	3
Hudson	0	Rhode Island	2
Hunterdon	25	Connecticut	1
Mercer	12	Georgia	1
Middlesex	10	Louisiana	2
Monmouth	29	Florida	2
Morris	21	Ohio	6
Ocean	7	Maryland	1
Passaic	7	Tennessee	1
Salem	8	Massachusetts	3
Somerset	16	Kansas	1
Sussex	5	Colorado	1
Union	18	California	3
Warren	11	Alabama	1
		Kentucky	3
	338	Utah	1
		Illinois	4
FOREIGN		Michigan	3
		Washington	1
Columbia, S. Africa	1	Oregon	1
Brazil	1	Texas	1
	2		110
Grand Total	450		

Cases by Interview. On a few occasions the owner of the flock in which the disease had appeared came to the station for help. In some instances careful questioning revealed the nature of the trouble and certain measures could be recommended, but in other instances no indication of the disease could be learned, and such an owner was instructed to bring or send in birds for examination. The distribution of cases handled by interview is as follows:

NEW JERSEY

Essex	1
Middlesex	5
Somerset	1
Union	3

OTHER STATES

North Carolina	1
New York	1
Pennsylvania	1
Total	13

Cases by Telephone. Some few cases were handled by telephone, and in most instances it was necessary to have the owner present or send birds for examination. The distribution of cases of this class was as follows:

Bergen	1
Essex	2
Mercer	1
Middlesex	18
Monmouth	1
Morris	1
Somerset	1
Union	3
Total	28

Experimental Projects

Four projects, named in the earlier part of this report under the classification of B projects, have been planned and started during the past year.

Work on project B1-23 is in active progress. The material for this study is supplied by the laboratory cases and a report has already been given above. The laboratory cases also furnish material for project B3-23. In this work a microscopic examination is made of the cecal contents of all birds examined at the laboratory. So far this study has shown that a large number of adult fowls carry a mild infection of coccidiosis. The largest percentage of birds are found to be affected during the warmer seasons of the year, but during the colder seasons the percentage of infection is reduced.

Some work was done on project B2-23 regarding *Heterakis Perspicillum.* The work on this project was interfered with on account of the difficulty in getting experimental chicks. However, it was possible to study some factors which influence the development of the egg of this nematode.

At the present time work on project B4-23 is not under way, although it is planned to start this soon. Soil samples representing various reactions have been collected, and the organisms to be used in this study are also at hand.

Educational Service

Under this heading are included meetings held for the purpose of discussing poultry-disease problems In all 20 poultry associations

were visited, 2 of these meetings being state association meets, and the remainder local organizations. The distribution of these meetings was as follows:

Middlesex	3
Cumberland	4
Passaic	1
Ocean	1
Atlantic	3
Hunterdon	1
Monmouth	1
Bergen	3
Mercer	1
Camden	1
Cape May	1
Total	20

In addition to the poultry associations the New Jersey Veterinary Medical Association was addressed on 2 occasions. The conference at the University of Pennsylvania was also attended and a talk given on poultry diseases.

A 2-days' short course was held for veterinarians and the various poultry diseases were discussed and demonstrated. This conference was well attended by New Jersey veterinarians as well by some from Pennsylvania.

Table 8 is a recapitulation and general summary of the poultry disease cases for the year.

TABLE 8

Summary of Poultry Disease Cases for the Year

CLASSIFICATION OF THE CASE	Number of Cases	Number of Autopsies	Diseases Found
Laboratory	400	1057	1331
Department Farm	197	982	1462
Bergen County Contest	70	70	103
Vineland Contest	72	72	126
Visit	12	22	24
Letter	450	....	....
Interview	13	....	....
Telephone	28	....	....
Totals	1242	2203	3046

Poultry Housing

During the past fiscal year 2 poultry housing experimental projects have been undertaken. In the first instance, that of the studies made under project F1-23, a report of progress can be made. A survey has been made of several existing types of poultry houses, primarily laying houses, with the idea of finding out just how efficiently they were presenting optimum conditions for the fowls housed during seasons of extreme temperatures, especially the winter season. The various houses on the department farm are being studied with regard to their fitness to this point, and plans for the remodeling of some of them are being prepared at this time. It is felt that the most economical and efficient type of laying houses for New Jersey poultry raisers is that one which will provide the optimum conditions of environment for the fowls contained therein, during the periods of extreme temperatures, at minimum cost of construction and maintenance. The house must be adaptable easily to average conditions.

The second housing project has been completed during the year and presented to the public in the Hints to Poultrymen for May, 1924, under the authorship of Mr. Thorp. There has been a consistent demand through recent years for a multiple unit brooder house, which would incorporate the using of the colony system of chick brooding, and still have the advantages of the long brooder-house system. The New Jersey Multiple Brooder House is the result of these investigations. It is designed in such a way as to make it an adjustable house, with movable partitions, so that it may be used practically the year 'round for some poultry purpose. Inasmuch as it is thoroughly described and fully discussed in the Hints, no further discussion is thought necessary in this place. It is a real accomplishment. In late June a letter from a poultryman in France indicates that the Hints describing the brooder house had furnished him just what he was looking for, and that he had erected a New Jersey Multiple Brooder House, was going to use it for pullets this winter, then install the partitions in late winter and transform it into a brooder house for the forthcoming season.

Cold Storage Holdings

Because of early demand for the information one project was reported in the July Hints to Poultrymen of 1923, covering a comparison of egg-production, temperature and cold-storage holdings in New York City. This work, done under Hervey's direction, was important and very interesting, as it showed some valuable correlations between season, temperature and cold-storage holdings.

Poultry Nutrition Studies

Two special projects have been under way during the past year, one dealing with the essential vitamins and their relation to poultry

health, and the other dealing with proteins of various animal origins for poultry feeding. The former problem was undertaken by Mr. Clickner and the latter by Mr. Gardner, graduate students in the research division of the department.

Vitamin Studies. Six pens, each containing 30 S. C. W. Leghorn pullets, were started on this project at the beginning of the production year, and all were housed under exactly the same conditions. The varying factors were the vitamins furnished in their respective rations. Pen 25 received all 4 vitamins, A, B, C and D; pen 26 received A, B and D; pen 27 received A, C and D; pen 28 received B, C and D, while pen 29 received a ration free of vitamins. The basal ration consisted of pearl hominy as a source of carbohydrates and fat, while tankage was used to supply the animal protein. Minerals were furnished in the form of Conn's Poultry Mineral mixture. Butter was used to furnish vitamin A, yeast for vitamin B, cod liver oil for vitamin A and D, and sprouted oats for vitamin C, as well as A. The enumeration of results will be presented in detail in an appropriate bulletin later in the year. In this place it should be stated that the varying results obtained in these 6 pens conclusively indicate that the practical poultry keeper should not neglect to remember at all times that there are elements or factors essential to poultry rations beyond the fundamental components of proteins, carbohydrates and fats so familiar to poultry feeders for past years, that the vitamins are undoubtedly among these essential factors, and that the fowls which are starved, so far as the vitamin requirements are concerned, will not only suffer the diseases which a lack of them always brings, but further will become easier prey to infectious disease organisms. The experiment of this past year points out the important possibilities of further studies along this line, and it is hoped that during the coming year, when the department farm is again established on a safe and healthy basis, this work in vitamin feeding may be enlarged and continued along fundamental lines.

Protein of Animal Origin for Poultry Feeding. During recent years much has been said of certain poultry feeds high in protein that have been prepared from animal origin. Probably among the first of these to be widely used was meat scraps. But in more recent days fish scrap, and the various milk products have been creating interest as well. An experiment was undertaken in which certain protein-bearing foods of animal origin might be tried as economical ingredients of the laying rations. This whole series of experiments, like those mentioned immediately above, will be published in due form in an appropriate bulletin, therefore, it is felt that only a mention of conclusions is in order in this annual report. It was felt in general that protein from an animal source yields far better results than protein from a vegetable source. However, protein of vegetable origin, supplemented by a suitable mineral mixture, is nearly as efficient as protein of animal origin. This bears up work done by Kennard at Ohio. Protein of vegetable origin, not supplemented by minerals, is only slightly better than no protein at all. Meat scrap and sour skim milk,

as foods containing protein of animal origin, usually yield the highest returns, and yield best results in fertility and hatchability of eggs. Powdered buttermilk gave better results than liquid buttermilk with good laying pullets, but proved expensive in feeding yearling hens, though a fair return resulted from its feeding. Powdered skim milk yielded a very good return for yearling hens. Fish scrap yielded good returns, but usually resulted in lowered fertility and hatchability and in high mortality in the laying pen. This should be repeated again before being taken as conclusive fact. High grade tankage yielded a high average egg production and profit over feed, but the hatchability of eggs was low. The order of efficiency of proteins of animal origin, obtained in this experiment, was dried skim milk, meat scrap, powdered buttermilk and fish scrap. It is necessary to feed protein of animal origin in order to secure the most economical egg production, good fertility and hatchability and low mortality in the laying pen.

Credit is due to Messrs. Clickner and Gardner for much fine work on the analysis of results in these latter two projects.

Departmental Participation in World Poultry Affairs

The department of poultry husbandry has grown to such size, as measured by its research, educational service and extension programs, that it is necessary for the staff to take a certain part in those problems of national and international scope which have to do with the general development and extension of the business of poultry keeping throughout this country and even the world. During the recent spring the poultry husbandman was requested to act as an American delegate to the Second World's Poultry Congress, held at Barcelona, Spain, under the auspices of the Spanish Government and under the personal patronage of the Royal Family of that country. Four weeks were spent in the deliberations of the Congress, and the New Jersey representative returned to the department with enlarged vision, wider experience and increased information concerning the poultry industry. It was possible for him to spend 5 weeks in England, where, as guest of the British Government, excellent opportunities were offered for an intimate study of the poultry industry of that great country. This participation in such international relationships has helped in infinite ways to increase the efficiency of the work of the department of poultry husbandry.

Report of the Department of Dairy Husbandry

JOHN W. BARTLETT

DEPARTMENTAL ACTIVITIES

The activities of the department of dairy husbandry can be listed under four different subjects, namely, Experimental, Extension, Creamery Inspection, and Advanced Registry.

1. *Experimental.* Data has been gathered during the year on the following experimental projects:

Project 1. Breeding experiment with dairy cattle.
Project 2. Rations for dairy heifers during winter months.
Project 6. Minimum milk requirement for raising dairy calves.
Project 10. Normal growth of dairy animals.
Project 13. The relation of the ductless glands to growth and milk production.
Project 17. The effectiveness of commercial preservatives in composite milk samples with special reference to bichloride of mercury.
Project 18. The effect of mold growth on the butter-fat test of composite samples.
Project 19. The relation of alfalfa meal as a roughage to mastitus in milking cows.
Projects 1, 2 and 10 are long time experiments. Progress is reported on each at this time.

The Relation of the Ductless Glands to Milk Production—Project 13

The animals used in this experiment were kept under the average herd conditions. Preliminary milkings and butter-fat tests were made for 2½ days on each animal preceding injections. The milk was tested and weighed during injections and for 2½ to 3½ days following injections. All of the animals were fed 10 pounds a day of the regular herd mixture, which consists of the following ingredients:

	lbs.
Hominy	800
Bran	400
O. P. linseed meal	200
Gluten	200
Oats	200
Brewer's grain	100
Cottonseed meal	100
Salt	40

As roughage, the animals were fed 10 pounds of hay, 20 pounds of silage and 4 pounds of beet pulp (dry weight) daily:

Animals Used

	Cow A	Cow B	Cow C	Cow D	Cow E
BREED	Grade Holstein	Grade Holstein	Grade Holstein	Grade Ayrshire	Grade Shorthorn
Age Years	7½	6	6	2½	9½
Milking months	8	6	7	2½	8
Bred months	6	4	5½	Open	6½

The materials used were as follows:

Desiccated Placenta	P. D. & Co.
Desiccated Mammary Substance	P. D. & Co.
Desiccated Thyroid	P. D. & Co.
Soluble Extract Ovarian Residue	P. D. & Co.
Powdered Fetus of Cow—4 to 4½ mos	H. W. & D. Co.
Powdered Fetus of Cow—5 mos	H. W. & D. Co.
Pituitrol Obstetrical	W. Co.
Corpus Luteum of Cow	W. Co.

Desiccated or powered substances were dissolved in Tyrode solution before injection.

In most of the previous work on dairy animals the experimenters used the subcutaneous or intraveneous injections. In this experiment intra-muscular injections were used exclusively.

Three check tests were made to find if similar results were to be noted in different animals with the same injections.

Interpretation

In experiment 1 [Fetal extract (4-4½ months)] there was a loss in both milk total and fat total. The most notable point in this experiment is the way the fat and milk parallel each other in the graph. The butter-fat test was normal throughout. It is possible to expect chalones to be present in the fetal extract, although what glands are the cause of it, it is impossible to say. Hogben and Crew claim that the ductless glands start to function in the fetus of an ox at 4 months.

Similar results should be expected from experiment 2. There is a decrease in milk total but an increase in fat. It hardly seems possible that a difference of 2 weeks to a month in age of fetus could

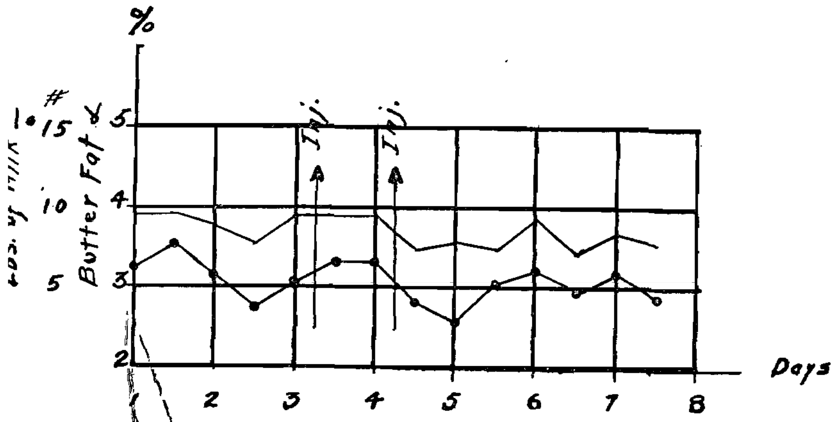


FIG. 1. Experiment I. Desiccated Fetus 4½ Months.

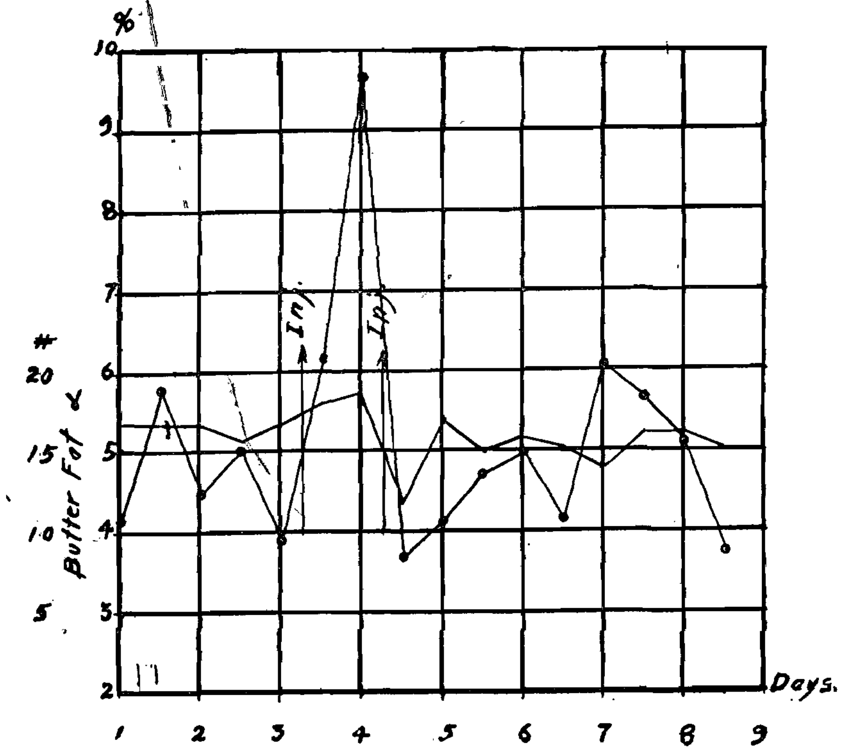


FIG. 2. Experiment II. Desiccated Fetus 5 Months.

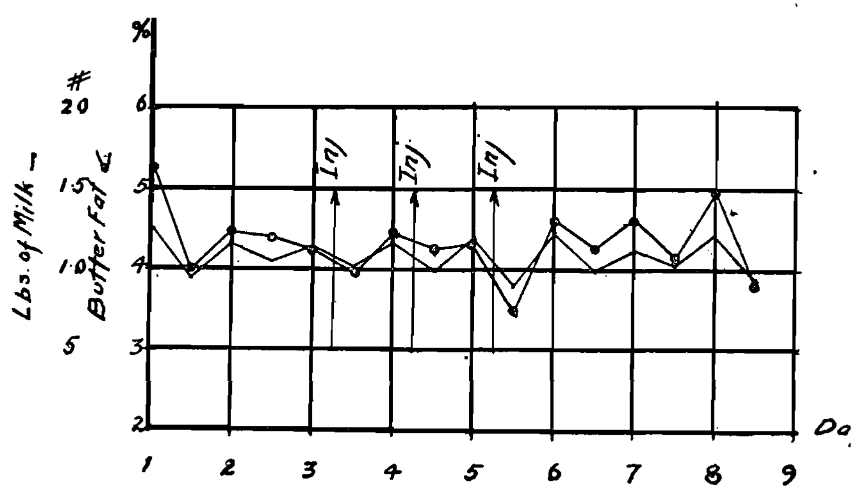


FIG. 3. Experiment III. Corpus Lutea.

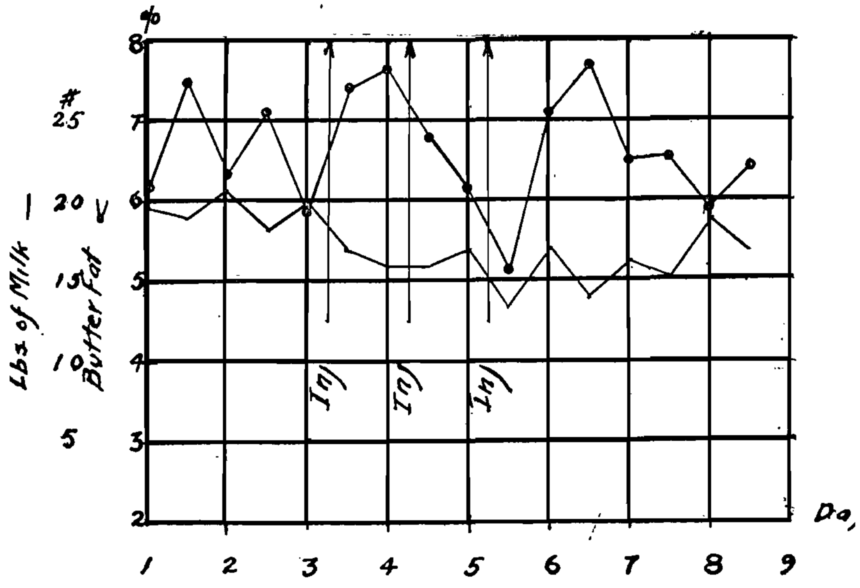


FIG. 4. Experiment IV. Desiccated Mammary Glands.

cause this difference. In injecting the same (5 months fetal extract) in a dose of 1 gm. into a different animal an entirely dissimilar result was produced, namely, an increase in total percentage of milk and a decrease in fat. This difference is probably caused by the differences in the adult animals used.

Experiment 3 showed a slight decrease in both milk and fat totals. It may be that copora lutea of pregnancy throw off chalones which act on milk production, but the difference noted here is not great enough to be basis for such a claim. Prenant, Landes and Srobansky, and Beidl say, "The corpus luteum function is to guard against the interruption of pregnancy by the prevention of ovulation." By preventing ovulation, milk secretion might be inhibited from the same cause, so that food material is diverted to the fetus instead of the milk. On injecting another animal with the same material, a gain instead of a loss of milk was noted.

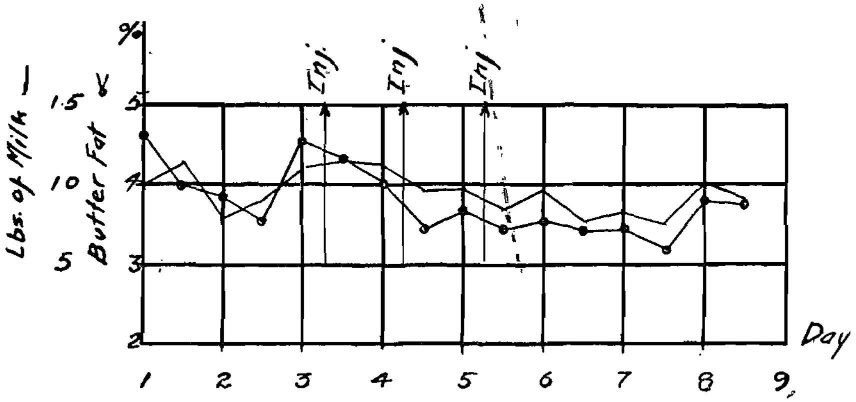


FIG. 5. Experiment V. Desiccated Thyroid. Corpus Lutea. Desiccated Mammary Glands.

In experiment 4, injections of desiccated mammary glands brought about a decrease in milk with an increase in the total amount of fat. The fat decreased slightly after the second injection, then came back to normal at the following milking.

Experiment 5, using a combination of desiccated thyroid, corpus lutem and desiccated mammary glands, caused a steady drop in both milk and fat, although the percentage of butter-fat increased. Again the milk and fat graphs paralleled each other to a marked degree.

In experiment 6 the results of placental injection were negative and similar to those obtained by Starling and Claypon and by Foa. On injecting another animal with similar material a slight gain in fat was noted.

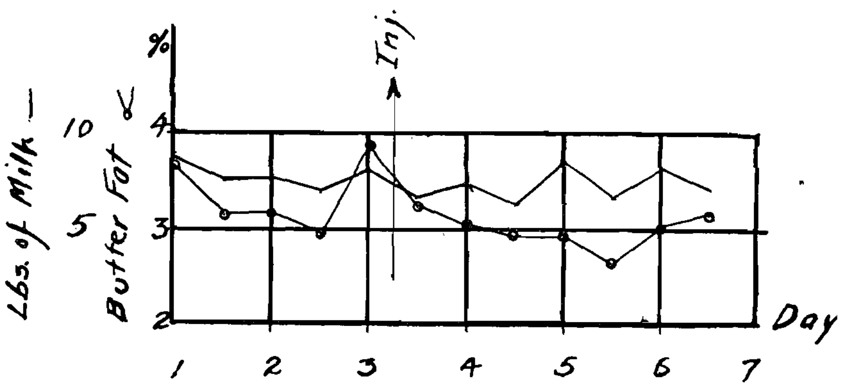


FIG. 6. Experiment VI. Desiccated Placenta.

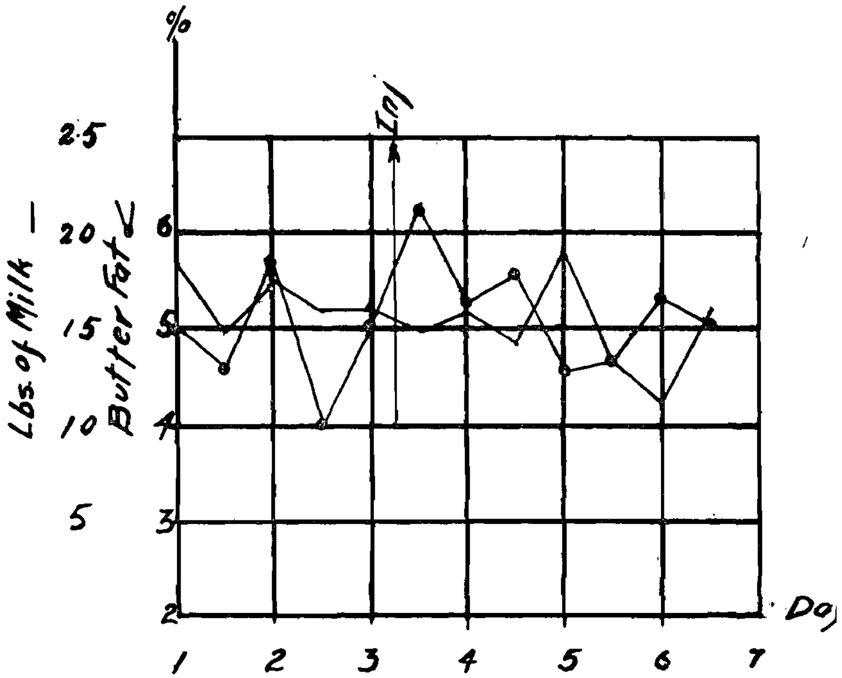


FIG. 7. Experiment VII. Soluble Ovarian Residue.

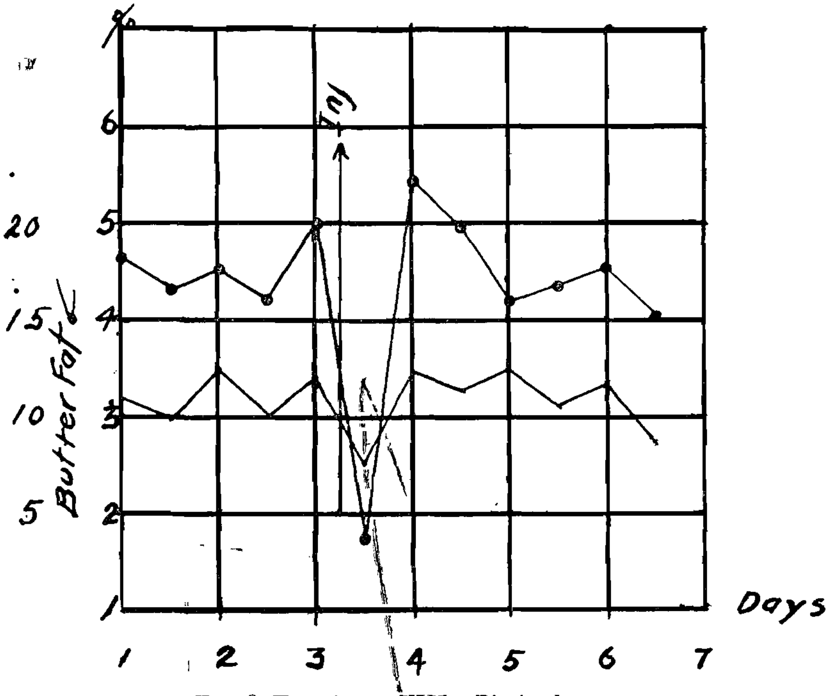


FIG. 8. Experiment VIII. Pituitrol.

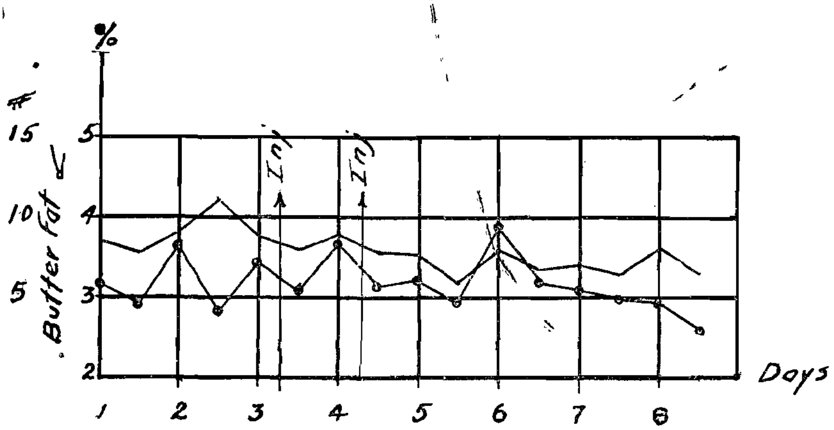


FIG. 9. Experiment IX. Desiccated Thyroid.

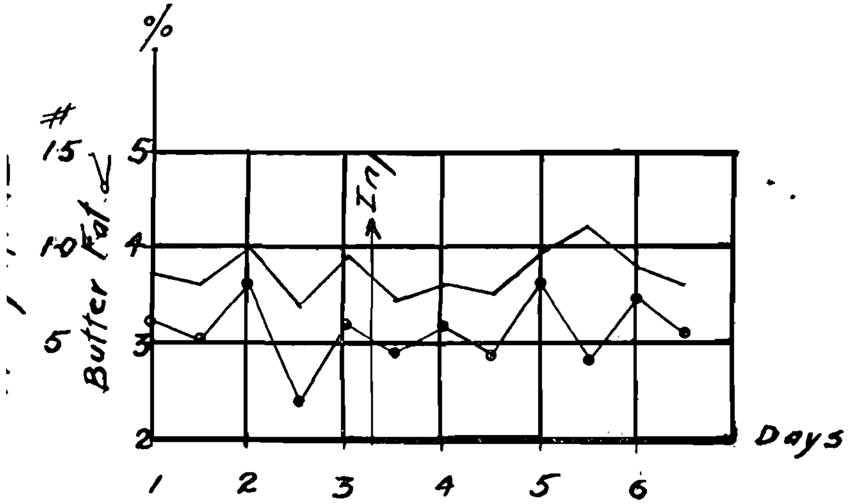
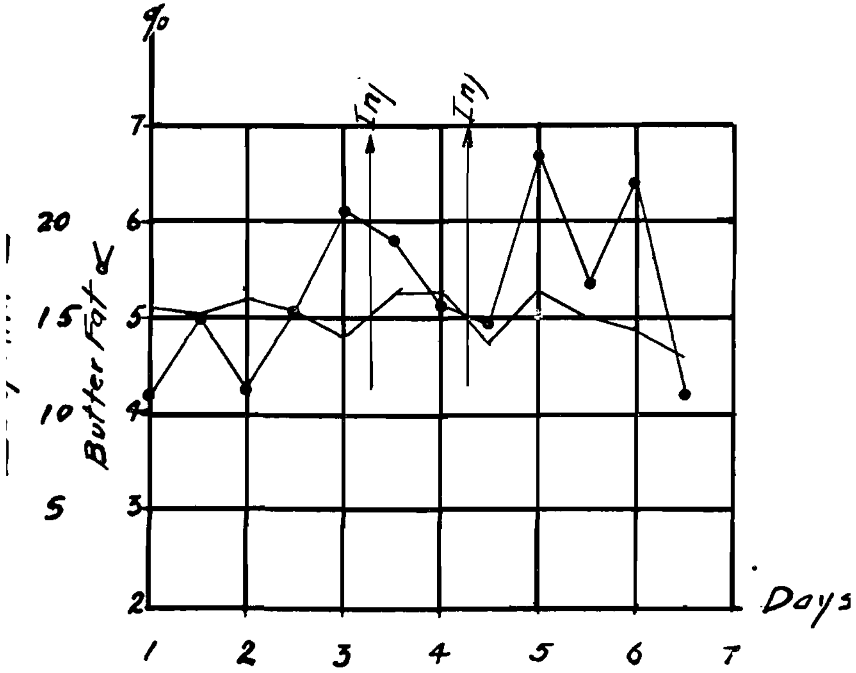


FIG. 10. Experiment X. Check Injections. Desiccated Fetus 5 Months.



In experiment 7, involving soluble ovarian residue, a drop in milk with an increase in total amount of fat was noticed. This animal developed a temperature of 102° after injection, which may have influenced the fat test to a certain extent. The relation between body temperature and concurrent fat production remains to be investigated.

In experiment 8 negative results were obtained with pituitrol injection, perhaps because "obstetrical pituitrol" was used. According to Hoskins, this causes a depression in tonus and in the peristalsis of the small intestines when given intraveneously.

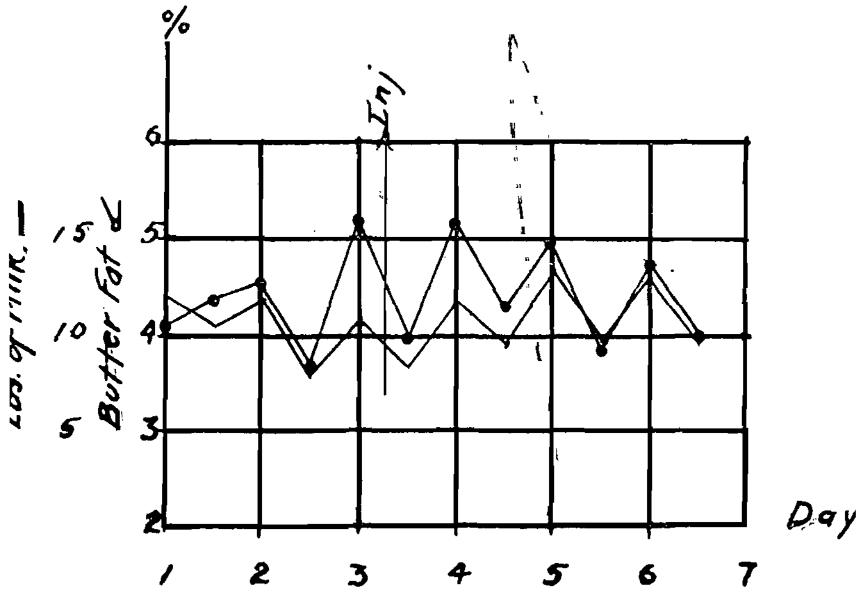


FIG. 12. Experiment XII. Desiccated Placenta. Check.

In experiment 9 a decrease of milk with a slight increase in fat was noted. As the thyroid gland becomes enlarged during the menses, and milk production drops during the heat period in cattle, it would seem to be natural to expect results of this sort when injecting desiccated thyroid glands.

Experiments 10, 11 and 12 were repetitions of 5-month fetal, corpus lutem and desiccated placental injections on different animals, and the results were different as noted above.

Conclusions

(1) From these results it would seem that injection of these glandular products in the first nine experiments caused usually a decrease in volume of milk. This might be explained by the possibility that these glandular products have a depressor effect on the blood pressure which caused a decrease in the

amount of blood flowing through the udder in a certain time. Consequently, the udder not being supplied with its normal amount of food (and possibly hormones), failed to secrete the usual amount of milk.

(2) The results would not lead one to believe it possible to increase milk or fat over a period of time by injection of glandular products.

(3) Injection of the same ingredients in different animals may bring about quite dissimilar results.

(4) In view of the findings stated in (2) and (3), and of the further fact that changes which were produced at all are small, it is probable that even with massive single injections no noteworthy effect is to be expected in the way of influencing amount or quality of milk.

Minimum Milk Requirement for Raising Dairy Calves—Project 6

The data collected during the past 3 years on this project have been summarized and will be published soon in the Journal of Dairy Science. Space will not permit a record of the work in this report. Further studies in calf feeding are being continued at this station with the thought of finding a practical dry ration upon which calves can be raised from early age. Reprints of the data collected on this experiment may be had by writing to the experiment station.

The Effectiveness of Commercial Preservatives in Composite Milk Samples with Special Reference to Bichloride of Mercury—Project 17

The department of dairy husbandry through its inspection division ran a series of experimental tests in the field to ascertain, among other things, the frequency and range of variations in the tests of milk delivered at a milk plant and their relation to the accuracy of fat tests made from one-day samples versus composite samples during a period of 15 days.

The tests were conducted at the Bridgeton plant of the Abbotts Alderney Dairies, Inc.

In this experiment the deliveries of milk from 12 patrons were studied. Samples were taken and tested daily from each delivery. Composite samples were prepared in the usual manner covering a period of 15 days. These were tested at the end of the period and the results compared with those obtained from the aggregate of single, daily samples. The pounds of milk delivered each day by each patron were recorded and the pounds of fat in the milk were obtained by multiplying the pounds of milk by the percentage of fat in the daily samples. From the total amount of milk delivered during the 15 days and the total amount of fat contained therein the true average of fat percentage was computed. The following results were obtained:

1. The percentage of fat in the composite sample checked in every case with the computed percentage as closely as could be determined by the Babcock

test bottle. The greatest variation between the two being 0.08 per cent.

2. The fat percentage in milk delivered from one day to another ranged in some cases .9 per cent higher than the composite test and .5 per cent lower on two successive days.

3. The fat percentage in milk delivered by the same patron varied as much as 1.4 per cent in a period of two successive days.

Summary

The fat-percentage variations found in milk deliveries at a country plant are similar to those found in the milk of individual cows and the variation in herd milk. Greater varations occur at times due to removal of milk for home use without proper mixing and to losses due to handling and hauling milk for delivery.

The determination of the fat percentage in milk by the testing of 1-day samples is not accurate for the estimation of fat in milk delivered during a period of 15 days.

The composite-sample method of fat determination is the most accurate, and checks with the average fat percentage obtained by computation from the pounds of fat and pounds of milk delivered during a given period.

The Effect of Mold Growth on the Butter-fat Test of Composite Samples—Project 18

Through the courtesy and cooperation of the Abbotts Alderney Dairies, Inc., the laboratory and equipment at their Bridgeton plant were used in this work. The following results were obtained:

1. When approved methods of caring for composite samples were followed, no mold growth was obtained. These methods were briefly as follows: (1) Keeping sample jars tightly stoppered to prevent evaporation, (2) keeping samples in a cool, dark place, (3) agitating samples daily, using a rotary motion in mixing the contents, (4) placing the full amount of corrosive sublimate preservative in the sample at the start, (5) thorough cleansing and sterilizing of the jars at the end of each test period.

2. The glass-stoppered sample jars were most efficient in preventing mold growth.

3. Rubber-stoppered bottles were most conducive to mold growths in the samples because the pores of the rubber furnished a breeding place for the molds which eventually seeded the milk samples.

4. The use of formaldehyde, or formalin, which is a 40 per cent solution of the former, for rinsing off and sterilizing the stoppers at the end of the test period, prevented mold growth.

Experiment to Determine Whether Alfalfa Meal When Fed to Dairy Cows Causes Garget—Project 19

Reports have been circulated throughout the state that alfalfa meal, when fed to cows, caused a garget condition in the udder. In order to determine the accuracy of this statement the following experiment was undertaken:

Nineteen Jersey, Guernsey and Ayrshire cows in various stages of lactation were used in this experiment. All of the animals were fed the regular herd ration consisting of—

	pounds
Hominy	800
Bran	400
O. P. linseed meal	200
Gluten	200
Oats	200
Brewers' grains	100
Cottonseed meal	100
Salt	40

The cows were fed grain in a 1-3 ratio and were given 20 pounds of silage and 4 pounds of beet pulp (dry weight) daily. As a roughage, for a 2-week period the cows were given all the alfalfa hay they would eat. The exact weight of hay consumed per cow was determined by weighing in and weighing out. Alfalfa meal was then substituted for hay during the next 2 weeks.

The milk from each quarter of every cow was examined for a visible sign of garget. Cow No. 355 showed a light case of garget in the left hind quarter.

The cows were fed as outlined above to determine the amount of hay consumed per day for a period of 2 weeks. The amount varied from 7.2 to 10.0 pounds per day.

Three days were allowed to make the change from alfalfa hay to alfalfa meal. The animals were then divided into three groups and the alfalfa meal was fed in the following way:

Group 1

Meal mixed with the grain.

Group 2

Meal mixed with molasses.

Group 3

Meal as a roughage after other feeds were cleaned up.

This was continued for 2 weeks and the cows tested daily for garget. During the feeding period no new traces of garget were found, but the case of cow No. 355 became more pronounced.

Conclusions

Alfalfa meal, when used as the sole source of roughage, does not seem to cause garget.

When a cow already is infected with garget, the feeding of alfalfa meal may increase the congestion of the udder.

2. *Extension.* During the past year the dairy department has cooperated very closely with the department of extension in helping to conduct several projects. These projects can be listed under 8 subject divisions, as follows:

1. Cow testing associations
2. Calf clubs
3. Feed service
4. Purebred sire campaign
5. Dairy tours and several meetings
6. Cooperation with breed associations
7. Encouragement of tuberculin testing and replacement of reactors with high grades and purebreds
8. Miscellaneous meetings.

There are now 6 active cow testing associations of which 2 are in Sussex County, 1 in Flemington, Mercer, Burlington and Salem Counties, respectively. One association in Sussex County is in its twelfth year. During the year a special classification for all association cows making 350 pounds of butter-fat as heifers or 400 pounds of fat as mature cows has been established under the name of "Register of Production." This has added much to the interest of cow testing asociation work in the different counties.

Boys' and girls' calf clubs have become a permanent feature of dairy extension work. While the dairy specialist is not directly responsible for calf club work, considerable of his time has been taken up in cooperation with club agents in promoting their calf club work. Calf club work not only helps in the development of farm boys, but in many cases has aroused parents to better dairy practices.

During the year a feed service has been started and is being published each month in "New Jersey Agriculture." This service gives the farmers a suggestive home-mixed ration to be used in connection with home-grown roughages.

Perhaps the greatest feature of this year's extension service has been through a purebred sire campaign conducted in Mercer, Burlington, Sussex and Warren Counties. Sussex was the first county in which the campaign was started. A canvass of one-third of the county revealed the fact that, approximately, 100 dairymen were willing to replace scrub bulls with purebreds. Mercer County reports 35 prospective buyers. Burlington and Warren have completed the survey and will soon start a canvass to learn how many dairymen are in the market for a registered bull.

There has been close cooperation between the department of dairy extension and the breed associations. The Guersney and Holstein Associations have been continuing their field secretaries through a period of 3 years. The good that has been done cannot be measured in terms of dollars and cents. They have their offices with the dairy department and work in close harmony with the extension specialist.

Accredited herd work has progressed to the point where it is recognized by all breeders in the state. Few men would think of buying cattle from an untested herd.

3. *Creamery Inspection.* For the year ending June 30, 1924. The inspection of creameries that buy milk from New Jersey farmers on the butter-fat basis is under the administration of the Agricultural Experiment Station. The legislation under which the work is conducted was enacted in 1920 (Chapter 75, Laws of 1920).

Each of the 82 plants, which buy on a butter-fat basis, have been visited at least three times during the year. Because of the continued cooperation between plant operator and inspector, samples have been carefully kept and tested according to approved methods. This has resulted in efficient work on the part of the licensed testers and a lessening of the number of samples to be retested by the inspector. During the year 2,246 samples were check-tested. With few exceptions, the condition of the samples was good, and the accuracy of the original tests was maintained in all the plants throughout the year.

Creameries Inspected

Table 1 shows the number of milk plants visited and the composite samples check-tested.

TABLE 1

Summary of Year's Inspection, 1923-24

COUNTY	No. of Creameries	No. of Inspections	No. of Samples Tested
Atlantic	1	2	4
Burlington	4	14	124
Camden	1	3	36
Cumberland	1	4	282
Hunterdon	21	60	297
Mercer	4	8	96
Ocean	1	2	18
Salem	5	20	216
Somerset	5	15	156
Sussex	27	83	624
Union	1	3	000
Warren	11	35	393
Total	82	249	2246

Testers' Licenses

Applicants for licenses have been examined at the experiment station on the first Monday of each month unless such date was a holiday, in which case the following Monday was set aside. This policy will be continued during the coming year. Milk-plant officials are advised to make applications in advance when any of their employees is to take this examination. Such cooperation will be appreciated, and it will, undoubtedly, be advantageous to the applicant.

A study of table 2 shows that the number of licensed testers is about the same as last year. The difference is due to the fact that fewer new licenses were issued. Candidates are examined on the testing of milk and cream. While no cream is purchased on the butter-fat basis, a tester often is required to test it in the plant. For this reason it is felt that a tester should be familiar with the underlying principles of both tests even though his contact with the farmer is concerned only with the sampling and testing of milk.

TABLE 2

Candidates Examined and Testers' Licenses Issued

	1920	1921	1922	1923	1924
Individual Examinations	40	100	55	42	35
Failures	7	10	2	3	0
New Licenses Issued	33	90	53	39	35
Licenses Renewed	70	79	122	143	145
Total	103	169	175	182	180

Weighers' and Samplers' Certificate of Approval

Seventy-four persons were approved as weighers and samplers. These men are approved by the inspector at the plants where they are employed. Since licensed testers do not need such certificates, this total represents men who can weigh and sample milk properly. It means that practically every plant has, at least, two men who can perform this important phase of the work, which insures the farmer an accurate test.

Permits to Purchase on the Butter-fat Basis

A permit is issued to the individual plants of the state that purchase milk on the butter-fat basis. These permits are issued free of charge and a record is kept showing the amount of milk purchased and handled by these creameries. They are issued for one year from July 1. The data, however, cover the receipts and production of each plant for the company's fiscal year, which often begins on January 1.

Inspection of Glassware

The glassware companies continued their support of our policy to calibrate reserve stocks of glassware instead of handling small individual orders. This has worked to the benefit of the manufacturers, the experiment station and the user, because time and money are saved to all. Purchasers of testing glassware are admonished to insist on

receiving calibrated Standard Glassware of New Jersey direct from the manufacturers. Glassware manufacturers continue to send only the most accurate glassware into the state. This is one of the best forms of insurance that the farmers have against incorrect fat-test records. Table 3 shows the number of milk-test bottles, cream-test bottles and pipettes that were inspected during the past year. A total of 7,902 pieces were inspected as compared to 3,309 during the previous year.

TABLE 3

Summary of Glassware Inspection

	Total Number of pieces	Number Incorrect	Per cent Incorrect
Milk-test bottles	4334	13	.299
Cream-test bottles	311	....	....
Pipettes	3257	18	.552
Total	7902	31	.392

Prosecutions

One milk company was found violating the provisions of the law and prosecution was instituted. The case has not been closed, but, undoubtedly, will be this summer. The farmers of the state are beginning to realize that they can better protect themselves against unscrupulous plant operators by assisting the experiment station in its administration of the inspection law. When they report any violations of the law that come to their attention, the experiment station can often check up on milk plants which might otherwise conceal their methods for a considerable period of time. Such cooperation between the producers and the station is being increasingly manifested, and is held in strictest confidence. They need not fear being involved because of the divulgence of information, which has as its ultimate end better protection of their interests.

4. *Advanced Registry.* During the past fiscal year advanced registry testing in New Jersey has decreased. One reason for such a decrease can be given as scarcity and high price of skilled labor. Another contributing factor was the low sales value of the most-widely distributed dairy breed. This decrease in sales value has evidently been the reason for a good many of our famous breeders to temporarily discontinue advanced registry testing.

Breeders with vision, who fully realize the advantages they derive from advanced registry testing, irrespective of the fluctuations of

market value, should feel greatly rewarded for their work, through the high production averages obtained with completed records of all breeds, thus showing the progress of all breeds. It is to be regretted that a great many animals have not had the opportunity of showing their real worth. As for the increased financial values derived from advanced registry testing, figures just completed by the American Guernsey Cattle Club show the average sale price of all Guernseys with advanced registry records sold at public auction to be $568.30 in comparison with animals without advanced registry records, which sold for an average of $271.53. Average sales price of Holstein-Friesian advanced registry cows sold during the past year at public auction was $348.93, while animals without records sold for $200.60.

Summary of Testing for the Year 1923-24

Cows tested semi-officially		Total number of semi-official tests	
Jerseys	70	Jerseys	400
Guernseys	382	Guernseys	1311
Holsteins	83	Holsteins	371
Ayrshires	22	Ayrshires	137
Brown Swiss	7	Brown Swiss	47
Shorthorns	0	Shorthorns	0

Total number of semi-official tests	2266
Number of breeders doing semi-official testing	50
Number of breeders doing official testing	28
Total number of breeders doing testing	78
Number of supervisors used for official tests	17
Number of supervisors used for semi-official tests	22

Number of official tests

7-day records	103
15-day records	1
25-day records	1
30-day records	22
41-day records	1
60-day records	1

The Dairy Herd

During the past year a herd of approximately 90 animals has been maintained. For the fifth consecutive year the whole herd has remained tuberculosis free.

Two calves were presented to the station. An Ayrshire bull was given by Mrs. John G. Winant, of Edgerstoune Farm, Princeton, N. J., and a Guernsey female by L. F. Loree, of Orange, N. J.

An average of 32 cows have been milked. Their total production was 165,720 quarts of milk. This gave an average yearly production

per cow of 11,070 pounds of milk. The total income from the herd was $16,031.58 from the sale of milk and $497.70 from the sale of stock.

Several cows have been placed on test during the year. Only 2 have completed yearly records to date. A Jersey cow, Rutgers Fern Della, made a record of 9,335 pounds of milk and 412.73 pounds fat.

Two Holsteins, which were tested for 7-day periods, gave records of 692 pounds milk with 22.479 pounds fat and 604.2 pounds milk with 19.5649 pounds fat. One Holstein cow, now on yearly test, has produced 19,000 pounds of milk in 9 months.

Records Made During Year

7-DAY RECORDS

Holsteins

7-year old—Burke Sadie Vale, No. 364769—692 pounds milk, 22.4794 pounds fat.

8-year old—Crestwood Pontiac Johanna, No. 276920—604.2 pounds milk, 19.5649 pounds fat.

Jersey

Rutgers Fern Della, No. 444192—365 days, 9335 pounds milk, 412.73 pounds fat.

A new dairy barn which will house 100 head of cattle has been completed during the year. This barn, with its nearness to the college farm campus, fills a long-felt need. It will very materially facilitate the possibility of research work. The department still needs a bull barn separate from the main barn. A barrack for the storage of roughage should be constructed at the rear of the main barn.

TABLE 4

Inventory of Animals in Herd

	Calves		Yearlings		Two years		Over 3 years	
	M.	F.	M.	F.	M.	F.	M.	F.
Holsteins	2	7	......	†5	*1	4	1	18
Guernseys	0	†2	......	7	*1	3	......	3
Jerseys	......	3	......	......	1	1	......	8
Ayrshires	1	2	......	3	*1	2	......	5
Shorthorns	......	......	......	2	......	2	......	......
Grades	......	1	......	1	......	1	......	3
Totals	3	15	......	18	4	13	1	37

*Animals loaned to the College

†One animal loaned

Report of the Department of Seed Analysis

Jessie G. Fiske

The seed laboratory during the past fiscal year 1923-24, has proceeded along the two usual lines of development, namely, the inspection and analysis of seeds sold in the markets of New Jersey with reference to their purity, germination and weed-seed content and the continuance of the free analytical service of seed samples submitted by farmers and growers of the state. The analytical service and the advisory assistance regarding the quality of seed for seeding purposes continues to be, as it has been in past years, a popular phase of the work. This is evidenced by the large number of samples, the results of which are shown in this report. There is sufficient evidence to prove that this work is very useful and also effective in the operation of the law, as a wider dissemination of knowledge is gained by this practice. Every effort will be made to give prompt attention to all requests of this nature.

ADMINISTRATION

The present seed law in operation for the past eight years regulates the sale of agricultural and vegetable seeds and provides for the inspection and analysis of all brands and kinds offered for sale in the markets of the state. The provision for and securing of an inspector whose services belong wholly to the seed laboratory, instead of the part-time arrangement of having the seed samples collected by other agencies, have done much to facilitate a complete inspection. Over 50 new seed dealers have been added to the itinerary during the past year.

The legume inoculant law enacted in 1919 requires dealers throughout the state to register annually with the department the brands of inoculants, the amount in terms of acreage, etc., to be offered for sale. Samples of inoculant materials are secured from the market for purposes of analysis and their value is determined. Reports of the findings of this inspection are made to the dealers handling the material.

During the year bulletin 397, the official report of the department, and circular 161, "Weeds of New Jersey," were issued from the department.

SEED INSPECTION

Official Samples

Samples of seed collected by the inspector from dealers in the stat are classified as official samples. This inspection during the pas year has been more complete and searching than in any year sinc the establishment of the laboratory. To date 1,235 samples of cro and vegetable seeds have been drawn and analyzed. A few hundre samples of fall-crop seeds, mainly cover crops, will be secured by th inspector during the next 2 months. A marked increase in the interes and cooperative attitude of dealers has been noted in recent year It has never been more noticeable than in this year's inspection. Th majority of dealers have not only presented their seed for sale i close conformity with the law, but they have manifested keen interes in all labeling requirements and the quality of seeds as a whole. A report is made to every dealer of the exact quality of all sample drawn from his stock.

Although the fiscal year terminates June 30, it seems best to dela the publication of the results of seed inspection until all data hav been collected as in previous years.

Unofficial Samples

Unofficial samples are those forwarded by farmers, dealers an growers of the state who are desirous of knowing the quality o certain seeds for seeding purposes. They are of all types and kind and are variable in viability and vigor. No information is given re garding these samples, their age, origin, etc. In fact, many are o questionable quality, and it is for this reason they have been for warded to the laboratory that their actual value may be determine During the past year 2,278 requests for unofficial analyses have bee made. This involves the making of 3,122 separate tests. It is evi dent that the services of the department are deemed of benefit b those who know its value, and it seems probable the scope of thi work will increase annually. The total number of requests for ger mination testing of vegetable seeds exceeds the number for crop seeds although it is apparent that the tests of crop samples represent muc larger quantities, in most instances bulk or carload lots. Evidentl the small gardeners and growers and dealers have been interested i seed quality, as they have requested 1,434 vegetable germination tests The total number of unofficial samples, together with average per centages in tests, is given in table 1.

PLANT IDENTIFICATION

The department has continued to make identifications of weed plants and weed seeds. It is believed that this information is considered of great value to the farmer, as the persistent requests for this knowledge demonstrate. Some cooperative work has been done with county agents along this line, and it is hoped the department may render even greater service in the future than in the past. The weed problem is becoming more serious yearly. A few troublesome plants have got a start in certain localities, and, apparently, are spreading through the agencies of the plant itself and the negligence of parties handling seed as well as the grower who plants it. The seed laboratory is attempting to disseminate knowledge about weeds, particularly the character of their growth and reproduction, that the farmer or grower may be better acquainted with the weed problem. With this end in view a record has been kept for several years of all plants sent into the laboratory for identification, their occurrence and distribution. Such a record kept over a series of years will enable the laboratory to tell what some of the worst weeds are and how they can be combated.

Much interest in this particular phase of the work of the department has been manifested by agricultural organizations and a few seed dealers. It is not uncommon to have sent into the laboratory weekly a number of samples of weed seeds with queries as to what they are and whether or not injurious. This demonstrates that the work of the department has created a desire for this knowledge, and that it is deemed beneficial to those who ask for it. It is also true that many dealers sending seeds to the laboratory for test request that the percentage of weed seed present in the sample be tested separately from the crop seeds that they may know the actual percentage of injurious material in the sample. The names of all weed seeds in ordinary analytical work are submitted to the sender for his information. The list of plants identified during the past year is given in table 2.

LEGUME INOCULATION

The inspection of legume inoculants in New Jersey during the past year has shown that practically no brands have been sold which have not been tested by the experiment station. Although commercial cultures are by no means the only material used for inoculation, nevertheless, it is safe to say from the amount of cultures handled by registered dealers that between 4,000 and 6,000 acres were inoculated by prepared cultures last year. This demonstrates the value of a close inspection of the stock offered for sale in the markets of the state.

Official Samples

Samples of inoculants handled by various dealers in the state, and collected by the inspector for analysis, are classed as official samples. The law requires every dealer in the state to register yearly with this department. In this registration he must give the brand and quantity of inoculant he is to sell, the length of time for which the culture will be valuable and the month and year of manufacture, together with the manufacturer's name. A number of these samples have been analyzed. For the most part these cultures have been found to be good and capable of inoculating the plants for which they were guaranteed. As the inspection is not complete until samples of inoculants for fall crops have been examined, no report of official work can be made at this time. This information will appear with the publication of the results of the seed inspection as in previous years.

Unofficial Samples

Practically no unofficial samples have been analyzed, as no requests for free analytical service have been made. A few requests for information about inoculants and inoculation value have been answered. Some time has also been spent in analyzing a number of new materials which have appeared in the market. Varying results in this work have been obtained.

No experimental work has been done with legume inoculants during the year, as nearly all the practical problems relating to the subject have been completed.

TABLE 1

Unofficial Samples Tested, 1923-24

Kind of Seed	Number of Samples Tested	Average Purity	Average Germination
		per cent	*per cent*
Grasses and Cereals			
Barley	3	....	96.67
Blue Grass, Canada	2	86.71	62.75
Blue Grass, Kentucky	17	83.28	68.44
Creeping Bent Grass	2	77.80	77.25
Fescue, Chewings	4	96.47	35.38
Fescue, Hard	2	87.66	32.75
Fescue, Red	7	92.28	73.79
Fescue, Sheeps	3	89.58	69.00
Fescue, Miscellaneous	5	87.94	71.00
Field Corn	333	....	97.39
Grass Mixtures	20	66.77	....
Millet	9	98.10	77.50
Oats	23	98.48	91.94
Orchard Grass	5	88.81	86.10
Red Top (Fancy)	11	88.78	79.50
Red Top (Chaffy)	8	42.95	78.25
Rye	2	96.76	53.25
Rye Grass	6	99.04	83.50
Sorghum	2	....	76.25
Sudan Grass	2	....	88.25
Timothy	44	99.45	91.69
Wheat	6	....	92.33
Miscellaneous Grasses	4	86.59	43.25
Miscellaneous	4	....	78.33
Leguminous Forage Crops			
Alfalfa	58	98.43	83.19
Alsike	72	98.69	89.48
Canada Field Peas	5	96.79	87.50
Cow Peas	13	96.90	81.23
Crimson Clover	17	97.26	72.96
Red Clover	80	98.89	89.95
Soja Beans	13	99.59	88.19
Sweet Clover	19	97.33	69.84
Vetch	35	97.80	78.32
White Clover	8	94.29	83.69
Vegetables			
Artichokes	1	....	72.00
Asparagus	14	....	82.43
Beans	167	....	84.96
Beets	56	....	73.09 bolls 136.53 sprouts
Brussels sprouts	1	....	41.50
Cabbage	90	....	72.06
Carrots	57	....	59.34
Cauliflower	27	....	67.22

TABLE 1—Continued

Unofficial Samples Tested, 1923-24

Kind of Seed	Number of Samples Tested	Average Purity	Average Germination
		per cent	*per cent*
Celery	58	....	59.24
Celeriac	4	....	50.75
Chervil	1	....	89.00
Chicory	2	....	45.00
Collards	2	....	10.75
Corn	53	....	82.16
Corn Salad	2	....	67.25
Cress	1	....	99.00
Cucumber	47	....	89.83
Dill	5	....	65.90
Egg Plant	13	....	73.42
Endive	12	....	62.38
Kale	5	....	72.60
Kohn rabi	5	....	71.50
Leek	5	....	57.20
Lettuce	116	....	85.29
Mangels	13	....	57.77 bolls 119.62 sprouts
Muskmelon	35	....	78.39
Okra	5	....	47.80
Onions	44	....	62.63
Parsley	17	....	57.50
Parsnips	8	....	42.31
Peas	138	....	88.94
Pepper	46	....	60.46
Pumpkin	22	....	83.36
Radish	66	....	82.09
Rutabaga	6	....	44.83
Salsify	4	....	57.25
Spinach	56	....	60.38
Squash	32	....	78.36
Swiss Chard	19	....	71.95 bolls 147.58 sprouts
Tomato	69	....	85.14
Turnip	47	....	73.93
Watermelon	28	....	84.05
Miscellaneous	17	....	58.09
Dandelion	1	....	49.50
Flowers			
Miscellaneous Flowers	17	....	77.24
Total	2278		

TABLE 2

Plant Identification

Common Name	Botanical Name	Source
Common Fern	*Asplenium bulbiferum*	North Plainfield, N. J.
Fern	*Dryopteris Species*	East Orange, N. J.
Stink Grass	*Eragrostis major*	Woodbury, N. J.
Smooth Chess	*Bromus racemosus*	New Brunswick, N. J.
Quack Grass	*Agropyron repens*	Swedesboro, N. J.
Oil Nut, Butternut	*Juglans cinerea*	Mays Landing, N. J.
Bloody or Red Veined Dock	*Rumex sanguineus*	Hackensack, N. J.
Japanese Knotweed	*Polygonum Zuccarinii*	West Milford, N. J.
Knotweed	*Polygonum maritimum*	Paterson, N. J.
Russian Thistle	*Salsola Tragus*	Trenton, N. J.
Knawel	*Scleranthus annuus*	New York City
Mullein Pink	*Lychnis coronaria*	New Brunswick, N. J.
Barberry	*Berberis vulgaris*	Pennington, N. J.
Sand Rocket	*Diplotaxis tenuifolia*	Englishtown, N. J.
Mustard Species	*Brassica Species*	Westfield, N. J.
Wild Sensitive Plant	*Cassia nicticans*	Bridgeton, N. J.
Wild Indigo	*Baptisia tinctoria*	Bridgeton, N. J.
Smooth small flowered Tick Seed	*Desmodium Marylandicum*	Lakewood, N. J.
Upright Wood Sorrel	*Oxalis stricta*	North Plainfield, N. J.
Violet Wood Sorrel	*Oxalis violacea*	North Plainfield, N. J.
Milk Purslane	*Euphorbia maculata*	Hackensack, N. J.
Leafy Spurge	*Euphorbia Esula*	Newton, N. J.
Rock Maple	*Acer saccharum*	Bloomfield, N. J.
Water Willow	*Decodon verticillatus*	Glassboro, N. J.
Tall or Western Centaury	*Centaurium texense*	Madison, N. J.
Storax	*Styrax Obassia*	Asbury Park, N. J.
White Vervain	*Verbena urticifolia*	Pennington, N. J.
Wild Ginseng	*Panax quinquefolium*	Colesville, N. J.
Ivy	*Hedera helix var. pedeta*	North Plainfield, N. J.
Motherwort	*Leonurus Cardiaca*	Pennington, N. J.
Mint	*Mentha rotundifolia var. variegata*	North Plainfield, N. J.
Bushy or Fragrant Golden Rod	*Solidago graminifolia*	West Milford, N. J.
Bushy or Fragrant Golden Rod	*Solidago graminifolia*	Belvidere, N. J.
New York Aster	*Aster Novi-Belgii*	Lakewood, N. J.
Fleabane	*Erigeron ramosus*	Sandy Hook, N. J.
Galinsoga	*Galinsoga aristulata*	Cape May, N. J.
Mugwort	*Artemisia vulgaris*	Bridgeton, N. J.
Swamp Thistle	*Carduus muticum*	Stockton, N. J.
Musk Thistle	*Carduus nutans*	Haddonfield, N. J.
Canada Thistle	*Cirsium arvense*	Trenton, N. J.
Canada Thistle	*Cirsium arvense*	Shrewsbury, N. J.
Chickory	*Cichorium Intybus*	Belvidere, N. J.
Common Sow Thistle	*Sonchus oleraceus*	Bloomsbury, N. J.

Report of the Extension Service

H. J. BAKER

The same general policies which have been in effect in the extension service in recent years have been maintained during this past year. There have been no important changes in organization or in methods of work.

In administration, special attention has been given to more intimate contact between the state office of extension and the county extension organizations. The extension director and state leaders have met regularly with the executive committees of the several county boards of agriculture, the county board of agriculture being the organization cooperating with the college in developing extension activities within the county. In the majority of counties regular monthly meetings are held, so that the administrative officers of the extension service, the county extension agents and the executive committees of the county boards of agriculture may meet and discuss extension problems. By following such a practice there is mutual advantage to the state officers and to the local county executive committee in deciding wisely on administrative matters; there is maintained a harmonious relationship between the college and the county extension organization; the extension work carried on within the county and throughout the state is conducted with a greater degree of efficiency. During the past year there has been a most excellent spirit of cooperation in all of the counties between the county extension service organization and the state office.

In two counties a slight change in organization has been made. This change makes what was formerly the county boys' and girls' club agent an associate county agricultural agent. Under this plan the two agents work with both adults and juniors. The field of agriculture is, to a certain extent, divided between the two agents. For example, one agent takes chief responsibility for extension work in general farming, dairying and field crops, working with both adults and juniors, while the other is chiefly responsible for fruit growing, vegetable gardening and poultry, working both with adults and juniors. This plan permits of selection of agents who are especially fitted for these particular enterprises. As a result it would seem logical to expect a higher type of service, not only toward the solution of agricultural problems, but also in enrolling more boys and girls. Whether it is successful or not will depend, first, upon whether the agriculture of the county is better served, and second, upon whether junior extension work grows. If this plan meets our expectations, it will be ex-

tended throughout the state, but expansion to other counties will be determined by results in these two counties after fair trial.

In determining the extension activities to be conducted within the respective counties, the extension specialists, county extension agents and county project committees have worked together. This plan has been followed for several years with increased effectiveness. The result has been a program of work based on the most fundamental needs of the farm and the home, united action on the part of specialists and county workers, improvement in methods of extension teaching, and greater activity by farmers and farm women acting as local cooperators in spreading the results of extension teaching. All of these things have contributed toward reaching larger numbers of persons, and in making the work of the extension service most effective.

There has been a relatively large number of resignations from our staff. Practically all of these resignations have come as a result of higher salaries or greater opportunity either in other lines of work, or in extension positions in other states. This is a serious handicap in developing an extension service. In order to conduct extension work most successfully, it is necessary, in the first place, to secure capable men and women as specialists and as county extension agents, and then to keep them, at least, for several years. As a rule the longer the period of service the more valuable the extension worker. To overcome this difficulty, it is necesary, first, that we raise our salary schedule, and second, that a definite policy be adopted with regard to graduate study. Increased salaries will meet competition from other states and business organizations. Opportunity for advanced study, after a certain period of service, will not only help to keep members of our staff longer, but will give a brighter outlook for professional improvement. Many members of the extension staff are asking the question: What are my opportunities for advancement? A definite policy allowing leave for advanced study would go a long way, in the judgment of the writer, towards dispelling this rather discouraging situation which now exists, and it is believed that it also would be a large factor in lengthening the term of service.

For two years there has been no increase in state or federal extension funds. The county appropriations have been gradually increased regularly for several years. The result of this condition has been an increase in the number of county workers, but an actual decrease in the number of state workers. Consequently, the specialized service from the agricultural college and the experiment station has been diminished. This is most unfortunate. It makes too heavy a load for those remaining on the staff, and makes impossible the meeting of an ever-growing demand made on the institution. Rather than cutting down on the amount of extension work, we should be increasing it.

The federal Smith-Lever appropriation increased gradually from 1914 to 1922. This allowed for growth. This appropriation reached its maximum in 1922. Growth now depends upon increased state appropriations. The state appropriations for extension work are con-

siderably less than the federal appropriations. It would seem reasonable to expect the state to appropriate, at least, as much as the federal government for extension work, and, if this were done, the extension service could develop in such manner as to meet much more satisfactorily the demands being made upon it.

Because of growth in the county work, and to lack of increase in state funds to meet this, the cooperation of the college in county work in dairying and poultry is especially handicapped. At one time two assistants to the extension specialists in these subjects were employed. Now, additional assistance in these fields is needed more than ever before. The state work in home economics also has been reduced. Assistants in these fields should be provided without further delay.

Last year's report pointed out that specialists in farm management, in agricultural engineering, in animal husbandry, in forestry and in marketing should be added to the extension staff. Through economy in administrative expenses, and in not filling several positions in which resignations occurred, a specialist in farm management has been added to the staff, and also financial assistance in adding three new county extension agents has been provided. It is not possible to make further economy in this direction. These other lines of work are still unprovided for.

Furthermore, the members of the resident college teaching staff and of the experiment station staff could do more extension work if sufficient funds were available to meet their traveling expenses. The extension service has no funds to pay the expenses of members of the experiment station and college staff, even when they go out on extension work.

Therefore, since the federal Smith-Lever appropriation has reached its maximum, the only way by which the extension service of the college and station may be further developed is by increase in the state appropriation. It is hoped that some increase in state funds may be secured another year, in order that normal growth, which is essential for efficiency, may take place, and thereby enable the extension service more nearly to meet the insistent demand for greater service.

COUNTY AGENT WORK

There has been little change in county agent work during the period covered by this report.

The number of demonstrations has remained about the same for the past two or three years, varying in so far as problems arise in some particular phase of farming. This constancy in the number of demonstrations is largely accounted for in the method of establishing the programs of work in the several counties through conference with groups of farmers known as "county project committees." This method of securing a program and enlisting farmer support in carrying it out, has prevailed for the past three years, and is proving a sound plan to follow.

The county project committee plan of securing a program of work is based on the premise that the specialist and county agent shall be prepared to furnish expert knowledge along the line of existing conditions in the counties as to, first, the status of its agriculture, and second, the problems of economic importance that may prevail together with what may reasonably be the trend of circumstances in the future. Analysis of the programs of work now being carried out, and a study of the results being secured from demonstrations, indicate the need of more intensive study of existing conditions, a greater knowledge of the status of the agricultural industry and a plan which will permit the interpretation of probable tendencies and developments for a considerable future period.

A piece of work recently established is illustrative of the points brought out above. The low price being received by the dairymen for their milk has brought to the front the question of breeding of better animals as one solution to the problem. This project is based on the use of purebred sires from high-producing dams.

The first step consisted in making a survey of all the dairy farms in the four counties taking up this project. Having this data, it then became possible to plan an intensive drive to place purebred animals on those farms where the project might reasonably be expected to produce results and help to answer these farmers' problems. The value of a careful survey is borne out by the fact that, prior to starting the project, it was the combined testimony of leading dairymen and the county agent in a certain county that from 75 to 90 per cent of the bulls in the county were purebreds. The survey, however, brought out the fact that 50 per cent of the bulls were scrubs. Of the purebreds many were not registered; thus no knowledge of their ancestry could be obtained. It is evident that through lack of surveys of this sort important lines of work may be overlooked or other lines of work taken up that are unnecessary, or, at least, of small economic importance.

Another question that arises in the present method of carrying on extension work has to do with the number of farmers reached through direct contact. A study of records covering a period of several years shows that there is a tendency to establish a clientele of a relatively small number of the farmers in a given county, these farmers being men of outstanding ability as growers of their respective commodities as well as leaders in all activities in their communities and counties. In this way demonstrations are likely to be placed year after year on the same farms, and, in general, the extension teaching limited to the few and oftentimes those least in need of it. The pure-bred-sire campaign referred to above is again illustrative of the point under discussion. It was the writer's privilege to aid in the farm-to-farm canvass in a certain county to sell the purebred-sire idea to the dairymen. The impression obtained was that the dairy industry in that county was practically an unbroken field for extension work, although the work has been going on in that county for nearly ten years and much good work has been done. While many leading dairymen have

availed themselves of the service of the extension office, it appears that the greater number still are little acquainted with the service that can be obtained and the possibility through the service of being in a position to answer their own specific problems.

It seems possible, with more careful surveys of existing conditions through having data to point out the fundamental problems facing the farmers, that intensive campaigns, aimed to reach large numbers, would result in greater results than are being secured at the present time.

County Boys' and Girls' Club Work

The plans of work that were submitted by the county club agents, together with the state leader's plan submitted for the year ending June 30, 1924, have formed the basis upon which club work has been conducted during the last year. The lines of work as outlined in the plans have been followed. It is not always easy to set down in a report just the progress that has been made, nor to state to what extent the things that have been done have contributed toward the solution of the problems of agriculture in a community or a county. If after a period of time it is found that there is a continued growing interest in any line of endeavor or service. it may very reasonably be assumed that the endeavor or service is of value and that it is meeting a need. Viewing the club work in New Jersey from this standpoint, we may conclude that the work is built on a sound basis, and that it is doing the thing for which it is designed.

From a recent tabulation made by the assistant state club leader, it was found that there were over 100 girls' clubs in the state working along definite lines of organized projects in clothing, millinery, foods and home management. Since then several new clubs have been started, including some canning clubs. A large number of these clubs have done continuous work since January, 1922. No club is started until there is a leader who will hold herself responsible for looking after the work. Every leader is given training either by the specialist or assistant state leader or both. This training consists in giving instruction in the subject-matter of the project and in having the leaders actually do the work under the direction of the specialists; it also includes the theory of the handling of a club, in keeping records and making reports.

Advance in girls' work during the year just passed has been marked by (1) more careful planning of project; (2) the building up of a system of leadership—this includes care in choosing leaders, systematic training and careful supervision; (3) keeping in touch with the work in the counties by the assistant state leaders through leader training groups, personal visits and reports from the clubs through the county club agent's office.

In the work with boys the outstanding lines of interest have been in dairying, poultry, swine and some phases of small fruits and vegetable crops.

The number of dairy clubs has shown a steady growth and the scope of their field of activities has greatly broadened. At the present time there are over 400 club members organized into clubs all under local leaders, holding regular meetings and following a carefully planned program dealing with such dairy problems as are met by all dairymen. Some of these clubs are now in the third year of their existence—one in its fourth. The progress of dairy club work can be indicated by the following: (1) Records that are being kept on the animals that have come into production. The records are forwarded to the state office and the records of animals showing production of 1,200 pounds of milk or 40 pounds of butter-fat are published in a monthly letter to dairy club members prepared by the specialist. (2) There has been a decided growth in interest in the eradication of tuberculosis during the year, largely as a result of dairy club work. (3) More purebred bulls have been put out during the last year than ever before. (4) Several purebred bull campaigns have been conducted in which the club agents participated.

In the poultry work there has been a very decided growth in interest, as indicated by reports received. Two lines of work have been emphasized, viz., the poultry management club, in which quite detailed records of costs of production are kept, and the calendar records, which are a less detailed record. The calendar has been a new feature in junior work during the past year. A letter to poultry club members, prepared by the specialist, goes out each month. It contains a summary of the reports of the club members and advice in practices for the month.

The work with swine grows slowly and reflects the general attitude of the farmers of the state on the question of pork production. While there is some interest in such crops as asparagus, sweet potatoes, tomatoes and sweet corn, the work in farm crops has made but little progress.

It is the belief of the writer that the future of junior extension work will depend to a very large degree upon our ability to organize the subject-matter to be taught around very definite farm problems, and then follow a carefully-prepared program of procedure with an objective of sufficient importance to hold the interest and attention, not only of the young people on the farms, but of the adults as well. Another factor that is important to consider is the age of the boys with whom the work is done. We believe that it should be with boys not younger than 12 years; 14 would probably be better. If the boys of that age can be interested, there is no reason why as great a percentage of the demonstrations that are started with them should not be successfully completed as are completed with men.

County Home Demonstration Work

The detailed program of work planned by seasons and announced in the early summer of 1923 has gone forward with comparatively few changes. Each specialist and each home demonstration agent has done

her part in making such a state-wide program convenient and possible. The plan has seemed to make for a clearer understanding of the limitations of the services of agent and specialist. The individual community has been more willing to make the seasonal plan a success by making and following a similar one.

Two state-wide meetings have brought to the attention of the department the fact that New Jersey women are increasingly interested in the extension service program and also in the part which the homemaker plays in that program. The first of these meetings was held in Trenton, January 18. Five hundred women representing 20 counties and 4 states came to attend the women's program and the annual meeting of the State Home Bureau. It was the most enthusiastic meeting of its kind ever held in the state.

The exhibit of the work, state-wide, which was planned to tell the home economics extension story, created a great deal of interest and involved the cooperation of women in 19 counties.

One of the most progressive features of "Agricultural Week" was the meeting of state and county project leaders assisting in developing the extension activities. Each specialist met with the state and county project leaders in her project to discuss the year's program and the principles of leadership as they pertain to that project. These sessions have helped to bring about a more intelligent understanding of the general extension organization and have made for closer cooperation throughout the organized counties. This was the most successful of the three such meetings held in New Jersey. Each specialist has made it a special feature of her work to find the right person and the right job for the state project leader.

The June Field Day held at the college was exceedingly well attended. At least 600 women representing 18 counties were present. The plan of the day was one to acquaint the women more closely with the institution and the work of the extension staff. The interest demonstrated by the women at this meeting and since that time will make it necessary for the department to plan more elaborately and for a larger group another year.

In no county has the executive committee of women, those serving in an advisory capacity to the home demonstration agent, shown decreasing interest in the work. Indeed, meetings seem to be more to the point, carried on with better procedure, and more of the women are taking an active part in reports and discussions. The meetings are of real help to the agent and increasingly worth while to the women. Leaders for both county and community work seem more easily located and more anxious to be of service to the county groups. A number of agents and specialists have expressed themselves as feeling that the quality of local leadership has improved to a marked degree. The women's committees are beginning to show a working interest in the Junior Home Economics program to the extent of feeling a responsibility for locating leaders for girls' groups.

The agents report that they are confident the goals which were established in the county programs of work will be reached by January

1, 1925. New communities have been organized in each county having a home demonstration agent, and, in each of these, clothing, foods and home management work has been conducted.

Farm Crops Extension Work

During the past year there have been 370 demonstrations in crops and soils as a result of the extension activities in farm crops. The main projects include soil improvement, alfalfa growing, corn variety demonstrations, potatoes and small grains.

Soil Improvement

The extension work in soils has included cover crop campaigns and green manure crop demonstrations.

Cover crop campaigns have been conducted in Atlantic, Bergen, Middlesex and Cape May Counties. The Atlantic County effort was most important. A survey on 110 farms in this county shows that these farms had 1,154 acres in cover crops, which was an increase of 23 per cent over the previous year. One of the local seed dealers reported that in 1922 he had sold 700 bushels of rye and 2,400 pounds of vetch seed; in 1923 he sold 1,050 bushels of rye and 3,200 pounds of vetch.

In the other 3 counties the efforts along this line were also productive of good results. For 1924, 8 counties have adopted the campaign idea of promoting cover crops, and will conduct their efforts in much the same way as outlined above.

Demonstrations on Green Manure Crops. There were several types of demonstrations used during the past year to help popularize these crops. One type was the cover crop comparison demonstration of which there were 13 in 8 counties.

Another type was the value of cover crop demonstrations. An excellent example of this type was established at the State Home at Jamesburg in 1921. Each year following, a market crop of sweet corn or tomatoes has been grown on the field. Also a winter cover crop of rye is grown on one section; a cover crop mixture of rye, vetch and crimson on another section; an application of manure, but no cover crop, on another section, and a fourth section has neither cover crop nor manure. In 1923, when the field was in sweet corn, the yields were as follows:

TREATMENT	Yield—First Pulling		Total Yield	
	ears	*lbs.*	*ears*	*lbs.*
Rye alone	324	205	450	287
Rye and legume mixture	282	228	510	394
Check. no cover	150	108	271	176
Manure, no cover	288	248	506	388

Alfalfa

Campaign in Warren County. A year ago both the crops and dairy project committees in this county declared for a strong program to increase the acreage of alfalfa. The specialist and the county agent of Warren, County, therefore, outlined a plan which has been followed almost in its entirety, and has been productive of good results.

The plan provided for a period of intense publicity in the summer and fall of 1923. One of the publicity features was to erect roadside signs, each sign to have at the top "Grow ALFALFA More." Under that caption many of the signs were to have brief statements of local interest regarding some nearby farm on which alfalfa was being grown. Sixty-eight of these signs were erected along the most traveled roads of the county. Another method of publicity used by the county agent was to send items to local newspapers regarding the experiences of certain Warren County farmers with the alfalfa crop. To date over 50 of these items have been issued and have been widely used by the newspapers of the county.

During the summer of 1923 four field meetings were held at successful alfalfa farms in order to show the value of the practices followed in growing the crop. At the meetings soil acidity tests were made for those men who brought soil to be analyzed. In the late fall of 1923 a series of 10 community meetings were held in various parts of the county. One of the features of these meetings was the giving of an illustrated lecture on alfalfa prepared by the specialist, many of the pictures used having been taken in Warren County. Sources of certified northwestern alfalfa seed had previously been investigated by the specialist, and at these meetings an opportunity was given everybody to place orders for seed through the county board of agriculture. This seed was to be delivered during the winter and sown in early spring, either on wheat or with oats.

Following these meetings two printed letters went to each farmer in the county telling him about the advantages of alfalfa and advising him about the distribution of seed by the county board. The second of these letters had an order blank on the back page, thus any man who had not previously done so could place an order for seed.

Knowing that lack of inoculation has been one of the causes for failure with the crop in the past, the county agent sent to every man who had ordered seed a small package of inoculated soil with brief but explicit directions on how to use it. Lime sources had been investigated and the information on this matter was furnished to the people who attended the meetings.

All these efforts were bound to produce results. During the past winter 71 persons placed orders for seed with the county board, the amount of seed ordered being 7,150 pounds. The agitation has also induced many other people to place orders with local dealers. The campaign is to continue for, at least, another year.

In the project committee meetings of the past winter 3 other counties declared for intensive efforts on alfalfa similar to those of Warren County. These counties are Sussex, Morris and Cumberland.

Demonstrations on Alfalfa. In 6 counties there are 9 demonstrations on alfalfa strains being conducted. The purpose of such a demonstration is to show the character of the several strains of seed used. Some of these were established in 1922 and some in 1923.

A successful alfalfa field may be considered a demonstration ready-made. Several counties have held field meetings at farms having successful alfalfa fields; Mercer had 1, Middlesex 2 and Warren 4.

Corn

Variety Demonstrations, Husking. In 1923 there were 85 demonstrations of this kind brought to completion in 5 counties. It may be stated that 57 of these were in Monmouth County and consisted in the wide distribution of the 3 kinds of corn which had been shown to be good in previous demonstrations. Salem, Morris, Mercer and Middlesex also had demonstrations on this project, in which a large number of strains were included. The principal varieties being pushed are Schmidt White Cap in north Jersey, and Hulsart and Reid White Cap in south Jersey.

Variety Demonstrations, Silage. After 4 years of demonstrations in Sussex County covering this point, it has been shown that the Schmidt White Cap is a first-class variety for silage purposes in that county. In the spring of 1924 twenty demonstrations were established in Sussex, comparing this variety with the farmers' own seed. In Warren County similar demonstrations with the same variety were established on 8 farms.

Other Extension Work with Corn. A number of farmers are carrying on simplified breeding of corn under the direction of the specialist and several of the county agents. This is confined to several of the varieties which have been found to be high yielding and generally desirable. Monmouth County has had a boys' seed corn club for the past two years in the Imlaystown section. A considerable amount of good seed corn of the Hulsart variety has been sold by the members of this club.

Ten counties during the past year held local corn shows and sent exhibits to the state show.

Potatoes

Better Seed. Inducing farmers to use better seed potatoes, and encouraging the growing of better seed potatoes in the south Jersey seed-growing district is one of the most important extension projects in crops. The main purpose is to stress the value of good seed. On account of the varying conditions under which the crop is raised in this state the character of this project necessarily differs in the several potato-growing sections.

Eight counties have listed for 1924 demonstrations on the subject of better seed. In these counties there are 12 of these demonstrations now being conducted, each with a fairly large number of sources. Some of the demonstrations are confined to Cobblers, particularly in the southern counties. In the central Jersey counties Cobblers,

Green Mountains and Giants, as well as other varieties, are represented.

In the fall of 1923 four demonstrations on late market crop potatoes, including Red Skins and Pink Eyes, were brought to a successful conclusion. This is the first serious effort in this state to isolate strains of these varieties which possess merit. As was expected, most of the strains showed a high percentage of disease, but some of them seemed to be worthy of improvement. Rogueing will be practiced this year on certain of these strains with a view to obtaining one or more strains which are good enough for certification.

Two counties, Camden and Burlington, have this year distributed certified seed of the Cobbler and Green Mountain varieties in large quantities to quite a number of farmers. This seed is to be tried out in comparison with the ordinary commercial seed on many of the farms. The results of this same effort in Camden County during the previous 2 years have shown that certified seed is distinctly superior to the ordinary seed, and this effort has exerted considerable influence in favor of the farmers purchasing better seed.

Other Potato Projects. In 1923 five counties completed 8 demonstrations on scab control. Five counties also conducted 20 demonstrations on spraying for the control of blight. Also, 5 counties successfully demonstrated the value of seed treatment on 40 farms. There were 7 auto tours held in 5 counties in 1923. Salem County, due partly to the activities of the extension agents, secured the certification of 300 acres of seed potatoes in 1923.

Small Grains

Wheat Varieties. In the fall of 1922 six counties, under the direction of the specialist, instituted wheat variety demonstrations in Monmouth, Burlington, Salem, Middlesex, Somerset and Warren. At harvest in 1923 it was shown that the Dawson's Golden Chaff variety held the high place it occupied the year before. In the fall of 1923 wheat variety demonstrations were again established in 5 counties with 7 demonstrations; 5 varieties beside the farmers' own were used in all cases. These 5 varieties are used throughout and are of the identical sources as those used in the experiment at New Brunswick.

Rye Varieties. Four counties, Monmouth, Warren, Burlington and Middlesex, undertook rye variety demonstrations in the fall of 1922. The results were variable, but they seemed to indicate that our native Jersey rye is nearly, if not fully, as good as any of the varieties brought in. In the fall of 1923 rye variety demonstrations were established in 3 counties, Burlington, Monmouth and Warren, with a total of 6 varieties. The demonstrations are organized in the same way as described above for wheat.

Oats Varieties. In the spring of 1923 oats variety demonstrations were established in Sussex, Warren, Morris and Somerset, with a total of 5 demonstrations. The varieties used, besides the farmers' own, were Kherson and Swedish Select. These demonstrations were organized as described above.

Dairy Extension Work

During the past year the dairy extension activities in New Jersey have been conducted in connection with the following main projects:

1. Cow testing associations
2. Calf clubs
3. Feed service (utilization of home-grown feeds)
4. Purebred sire campaigns
5. Dairy tours and field meetings

Cow Testing Associations

There are now 6 active cow testing associations in the state. They are as follows:

Name of Association	*Tester*	*County*	*Number of Cows on Test*
Sussex County No. 1	Robert Morrow	Sussex	600
Sussex County No. 2	Elmer Hyatt	Sussex	550
Flemington	Warren Wagner	Hunterdon	450
Mercer	E. C. Haaf, Jr.	Mercer	300
Burlington	Lawrence McHenry	Burlington	250
South Jersey	Wm. L. Spencer	Salem-Cumberland-Gloucester	500
Total Number on Test			2650

In the last 6 months an effort has been made to stabilize these associations by having the members sign an agreement to continue their herds on test for a full year. This has been done in 3 of the associations.

Register of Production

A special classification for all association cows making 350 pounds of butter-fat in heifer form, or 400 pounds as mature cows, has been established during the past year. Inasmuch as the grade and common cow will be our main dependence for milk production for generations, it seemed desirable that all association cows, irrespective of their breeding, should be given a chance to enter an "exclusive list" or honor roll. Owners of register of production cows can easily be persuaded to use better bulls. This first year's experience with the register of production revealed the interesting fact that all cows winning a certificate were either grades or purebreds.

In a recent public sale of surplus stock by a member of the Flemington Cow Testing Association, a register of production cow "topped" the sale at $190.

A summary of the records of the herd owned by a cow testing association member reveals an interesting relation between production and profit over feed cost, and is an unanswerable argument in favor

of good cows developed by proper breeding, feeding and selection. These records were completed in March, 1924, and the milk prices received were comparatively low throughout the previous 12 months, the average being $2.28 per 100 pounds of milk. A summary of this herd is as follows:

Yearly milk produced per cow	Yearly fat per cow	Value of milk sold	Total feed cost	Profit over feed
lbs.	*lbs.*			
18,675	556.5	$413.63	$115.71	$298.83
14,492	405.7	320.39	111.86	208.54
13,733	422.3	315.96	113.34	202.62
11,849	383.7	275.10	107.60	167.40
11,151	377.1	254.06	97.75	163.31
9,696	307.6	220.93	97.16	123.77
8,778	280.5	210.45	94.08	126.30
8,630	251.4	191.77	95.49	96.28
8,471	292.4	210.82	102.01	108.77
7,948	256.2	178.07	89.11	89.94
7,673	221.5	153.30	92.26	41.42
Total 121,095	3754.9	$2744.48	$1116.37	$1627.18
Average per cow 11,008	341.3	$249.49	$101.48	$147.92

A grade Holstein No. 14, owned by a member of the Sussex County *Association, recently finished her tenth year in the cow testing* association. The size of her yearly records and the persistency with which she produced is equalled by few cows in the United States. Her records follow:

Year	Milk	Butterfat	Value of milk sold	Total cost of feed	Returns over feed
	lbs.	*lbs.*			
1914	9,176	341	$157.82	$69.11	$88.71
1915	13,004	427	257.82	92.00	183.82
1916	12,624	468	276.68	92.25	184.43
1917	12,262	451	321.25	93.87	227.38
1918	11,432	415	384.90	123.07	261.03
1919	11,365	395	428.34	140.82	287.52
1920	11,197	400	405.50	131.25	274.25
1921	10,196	316	354.13	112.38	241.75
1922	11,535	368	390.54	108.61	280.91
1923	9,853	324	349.64	114.57	235.07

Most years hay was fed 7 months and silage sometimes longer. In the 10-year period she consumed 18,000 pounds of hay and 110,983 pounds of silage.

In 1923 the owner of this cow had a herd of 47 cows of various ages that completed the year in the testing associations. The average production per cow was 8,500 pounds of milk and 303 pounds of butter-fat. This exceptional average has largely come about by the use of purebred bulls and the testing association. The herd manager stated, "When we went into the testing association 10 years ago, our herd average was much lower. The association has revealed No. 14 and some other real goods ones from which we raise heifers."

Boys' and Girls' Calf Clubs

Assistance has been given to calf club members in selecting the best type animals for the Trenton Fair and the National Dairy Show. The following counties were represented at the Trenton Fair in 1923:

	Number of Animals
Burlington	17
Cumberland	3
Hunterdon	5
Mercer	19
Middlesex	14
Monmouth	11
Morris	10
Ocean	1
Salem	3
Somerset	3
Warren	4
Total	90

Twenty-nine of the best of these 90 head of animals were taken to the National Dairy Show at Syracuse, and succeeded in winning 23 ribbons and $300 in prize money. New Jersey won first on her state Holstein club herd, first on Jerseys and second on Guernseys. Such an accomplishment had never before been equalled by the calf club herds of any state.

Measuring Results

The true value of any extension activity is the extent to which it induces the individual to change from old methods to new.

In the vicinity of Montana, Warren County, no tuberculin testing had been done prior to the organization of the calf club 10 months ago. Today the 7 herds in which there are club heifers are under state and federal supervision for the eradication of tuberculosis.

The Mt. Airy Calf Club of Hunterdon County has been directly responsible for the replacement of grade bulls with purebreds by the fathers of 5 members. An interest has been awakened throughout the whole community in the value of showing at fairs, training in judging and better feeding of stock.

In order that the club heifers of Sussex County might not be exposed to tuberculosis while on exhibition, the directors of the Branchville Fair passed a ruling providing that only tuberculin tested animals will hereafter be admitted to the shows.

In Cumberland County there are at present 6 club heifers in milk on as many different farms. They are now on yearly test in the South Jersey Cow Testing Association by virtue of the fact that the fathers of the young owners put their herds on test when the association was reorganized a few months ago. The value of yearly records had constantly been emphasized to the members at meetings and in letters, and the fathers probably felt that, if monthly and yearly records were helpful in club work, they should likewise be beneficial in the conduct of the entire herd.

Feed Service

Beginning in March a monthly feeding and ration service was established. Timely rations based on latest feed prices are suggested and published in *New Jersey Agriculture*. Seasonal hints on dairy management are given in connection with this ration service. The suggested grain mixtures are devised so as to include as a base such home-grown grains as corn and cob meal and oats. More legumes and high quality silage or beets are being urged.

Feeding Practice Survey in Warren County

In March, 45 farmers in Warren County were visited by the county and club agents, farm management specialist or dairy specialist to ascertain the relative economy of alfalfa and poor-quality hay. This survey showed:

1. That farmers who grow alfalfa have the greatest net income from milk.
2. That cows fed alfalfa produce more milk and are in better flesh than those not receiving alfalfa.
3. That farmers who grow alfalfa use more up-to-date practices in dairy management than those not growing it.

The facts and figures collected are being used by the county agent of Warren County in furtherance of the alfalfa campaign now being conducted.

Purebred Sire Campaigns

Last winter purebred sire campaigns were put on in Sussex, Mercer, Burlington and Warren Counties. The Bureau of Markets of the State Department of Agriculture and the state breed associations cooperated with the extension service in this important project.

The general plan of the campaigns that have been inaugurated in the above 4 counties is as follows:

1. A survey is made to ascertain the number of purebred, grade and scrub bulls in the county and the number of farms on which heifers are raised.
2. By news articles, meetings and letters from the office of the county extension service and the local banks, the necessity for more economical production by the use of well-bred registered bulls is stressed.
3. A canvass is then made among dairymen who raised heifers sired by grade bulls, explaining the campaign and giving information regarding the time and place of the purebred bull sale and the method of conducting it.

Sussex County was the first to begin the campaign the past spring. A canvass of one-third of the county revealed the fact that approximately 100 dairymen who had been using grade and scrub bulls were willing to buy purebred bulls, if satisfactory arrangements regarding the purchase price and quality of bulls could be made.

With the aid of the State Holstein Breed Association 23 purebred bulls, ranging from 4 weeks to 18 months of age, were secured, and a sale was held on May 24 at Franklin Furnace. The bulls were sold at an average price of $52.50, and, so far as could be learned, every purchaser was satisfied with the animal he secured.

Mercer County finished the survey and canvass during the month of May, and reports 35 prospective buyers of purebred bulls.

Burlington and Warren Counties have completed the survey and will soon begin the canvass among the dairymen for the purpose of learning which dairymen are in the market for a registered sire.

Dairy Tours and Field Meets

During the year 10 dairy tours and field meets have been conducted, the purpose of which was to enable the dairymen and their families to see what their county and surrounding territory had to offer in progressive dairy practices. On these tours and at these meets a demonstration on judging dairy cattle was usually given, and, in some cases, judging or guessing contests were held for all those present.

EXTENSION WORK IN FRUIT GROWING

The season of 1923 shows that the emphasis which the extension service and experiment station have laid on quality in fruit production has not been exaggerated. Only good fruit was able to command a market, while poor fruit either brought such low returns as to give no profit, or could not be disposed of at any price. The program of work, which has been followed in fruit growing during the past year, has been based on the desirability of increasing quality. The main features of the program are as follows:

1. Pruning				121
a. General pruning demonstrations			78	
b. Continued apple pruning demonstrations			14	
c. Continued peach pruning demonstrations			13	
d. Continued grape pruning demonstrations			16	
2. Spraying				38
a. Apple spraying demonstrations			19	
b. Peach spraying demonstrations			5	
c. Peach dusting demonstrations			2	
d. Grape spraying demonstrations			5	
e. Dusting home fruit garden			3	
f. Home mixing of Dry-Mix Sulfur Lime			4	
g. Special insect and disease control work				
1. Codling moth observation cages		17		
2. Spray card service		13,882		
To apple growers	6085			
To peach growers	4710			
To cherry growers	1662			
To grape growers	1425			
3. Paradichlorobenzene service cards to peach growers	4710			
3. Demonstration Apple Orchards				15
4. Orchard Cultural Demonstrations				16
a. Apple thinning demonstrations			6	
b. Peach thinning demonstrations			7	
c. Peach picking demonstration			1	
d. Soil improvement demonstration			1	
e. Height of heading apple trees demonstration			1	
5. Small Fruit Demonstrations				28
a. Grape pruning demonstrations (listed under pruning)			16	
b. Grape spraying demonstrations (listed under spraying)			5	
c. Grape fertilization demonstrations			4	
d. Strawberry cultivation demonstration			1	
e. Raspberry variety demonstrations			2	
6. Organization				
a. Counties with fruit project committee			17	
b. Counties holding fruit project committee meetings			13	
c. Fruit growers' associations			6	
d. Fruit growers' school			1	
e. Auto tours			7	
f. Shows, exhibits, etc.			33	

The results of pruning demonstrations, given four and five years ago, are being seen plainly now throughout central and southern sections of the state, where large numbers of orchards are being reno-

vated after the manner of renovation demonstrations which were put on by the county agents and extension specialist at that time. The aim in this renovation work is to bring back the heads of the trees, so as to lower the tops, thus making thinning, spraying and picking easier, and to force out new growth in the lower parts of the trees, thus bringing the fruit-bearing surface nearer the ground.

Tabulated results of this pruning work follow. The difference in insect and disease control as a result of the pruning was negligible, but as the check trees ran over 30 per cent perfect fruit, and were practically free from scab, the spraying data have little significance this year. It is interesting to note, however, that there was a saving of 1.1 gallons of spray per tree on the heavily pruned block.

This demonstration gave the following results:

Yield per acre of apples over 3 in. in size	
Pruned	356 bu.
Unpruned	234 bu.
Yield per acre 2½ to 3 in. in size	
Pruned	184 bu.
Unpruned	277 bu.
Yield per acre less than 2 in. in size	
Pruned	117 bu.
Unpruned	263 bu.

The grape pruning demonstrations serve, for the most part, to show the advantages of the 4-arm Kniffen system over the various systems now in vogue among the New Jersey grape growers, who have very little system to their grape pruning, merely training the vines along one low wire, or, perhaps, a post. In the demonstrations the Kniffen, with the top wire 5 to 6½ feet from the ground and the bottom wire 2½ to 3 feet below this, gives larger clusters, better-sized berries, better growth of vine and increases production. It is also easier to spray the vine.

The results from the demonstration on the farm of Charles Karrar, Egg Harbor, Atlantic County, deserve special notice. This pruning demonstration showed a profit of $92.76 per acre.

Spraying

The season of 1923 was quite dry, and there was very little fungous or insect injury done to the fruit. For this reason, the results of the spraying demonstrations were not of outstanding value. In all, 49 spraying demonstrations were given. Of these, 28 were a comparison of the New Jersey Dry-Mix Sulfur Lime, which has just been recommended by the experiment station for general use as a milder fungicide to take the place of concentrated lime-sulfur. The Dry-Mix gave excellent results in all places where it was used, but there was so little disease injury, even on the unsprayed check trees, that this work was but of slight value.

A comparison of Dry-Mix Sulfur Lime and self-boiled lime-sulfur and atomic sulfur on peaches was carried on at the farm of

D. G. Gaunt, Mickleton. Here it was shown that the Dry-Mix Sulfur Lime was most effective in controlling the brown rot and peach scab, self-boiled lime-sulfur was second best, and atomic sulfur third.

Codling moth cages were run in many representative counties in all parts of the state. Due to the difference in latitude and altitude in south and north Jersey, it is necessary to maintain these cages in order to find out the exact dates of emergence of the codling moth. These cages were run in 5 counties for the second brood codling moth last July, while this spring they have been run in 13 counties on the first brood codling moth. The trees are now banded in practically all of the counties in order to get larvæ of the second brood codling moth for the cages.

One of the outstanding pieces of work done by the extension service is the maintenance of the spray-card service. A set of cards, covering all sprays on peach, apple, cherry and grape have been prepared, giving the time of each application, the insects which are to be combatted, the material used, and any notes on the application. These cards are sent out by the county agent a day or so in advance of the proper date to make the application in his county. (See program of work, page 179, for exact number of spray cards sent out this spring.) In addition to this spray-card service, a card advising the growers about the application of paradichlorobenzene for the peach tree borer was prepared and sent out from the county agents' offices. During the past year 3,911 cards have been sent out.

Demonstration Orchards

In the northern part of the state 15 demonstration orchards were carried on during the season of 1923, and an equal number are under way at the present time. The purpose of the demonstration orchard is to show the value and possibilities of the small farm orchard in communities where fruit growing is of minor importance and where the modern methods of pruning, spraying and fertilization are not being practiced. All of these operations are carried out in the demonstration orchard under the direction of the specialist and county agent, the owner of the orchard furnishing the material and doing practically all of the work, except the spraying of certain trees which the county agent or specialist does, in order to be sure of some properly sprayed trees at the time of the meetings, which are held in the fall. Results on these demonstration show a decided increase in the quality and yield of fruit, and, hence, in profits.

Demonstration Orchard, Passaic County

Sprayed	34 bu.
62 per cent—A. grade fruit	
20 per cent—B. grade	
18 per cent—Culls	
Unsprayed	17½ bu.
26 per cent—A. grade	
34 per cent—B. grade	
40 per cent—Culls	

The results of these demonstration orchards can be seen in the increasing interest in small farm orchards in the northern section of the state, which are now being much better taken care of in most sections than formerly. It can also be measured by the purchase of spraying machinery in sections where formerly no spraying was done.

Orchard Cultural Demonstrations

On one farm, where Hiley were thinned, it was shown that an increase of 19 cents per round bushel basket was received for the thinned fruit over the unthinned fruit, while the crops of the thinned and unthinned trees both ran approximately 4 bushels per tree, giving a net increase in the value of the crop, due to thinning, of approximately $45.00 per acre.

An orchard fertilizer demonstration carried on in Middlesex County showed that nitrate of soda was very efficient in giving increased crop to Ben Davis apples. Nitrate of soda was applied in 1922 and 1923 at the rate of 5 pounds per tree to one block, while another block, which received no nitrate, was used as a check. The value of this demonstration is clearly shown in the following results:

Nitrated	Averaged 6.5 bbl. per tree
Unnitrated	Averaged 4.3 bbl. per tree

Eight demonstrations on the control of the short-tailed pine mouse, the long-tailed meadow mouse and rat were carried on in the 4 northern counties of the state in cooperation with the Bureau of Biological Survey of the United States Department of Agriculture. Many of the growers have used the bait method of field-mouse control in orchards the past winter as a result of these demonstrations.

Organization

Fruit growers' associations have been organized in Bergen, Sussex, Middlesex and Mercer Counties. These associations meet regularly, either once a month or every six or eight weeks, during the fall, winter and spring, and have discussions on pertinent horticultural topics. The North Bergen Fruit Growers' Association at Allendale, Bergen County, is the most successful of these organizations. It was founded 3 years ago through the efforts of W. Raymond Stone, the county agent, and its success has been largely due to the work of Mr. Stone and D. H. Tice & Sons, at whose place the association meets. The membership at the first meeting was 42, and it has grown from that number to a membership of 125.

Seventeen counties have fruit project committees, 11 of which met the first year and cooperated with the extension specialist and county agent in preparing a county program of fruit extension work.

VEGETABLE GARDENING EXTENSION WORK

During the past year 6 comprehensive vegetable projects have been drawn up covering the extension work in vegetable gardening. These projects are—

- Seed Selection or the Home Saving of Seed
- Plant Growing and Plant-Growing Structures
- Disease Control, including
  - Spraying
  - Seed Selection
  - Sterilization of Seed and Soil
- Insect Control, including
  - Spraying
  - Dusting and Fumigation
- Variety Standardization Demonstrations
- Fertilizer Demonstrations and Cultural Practices

Seed Selection

In demonstrations to show the superiority of home-saved seed through individual hill or plant selection, the crop produced has shown practically 100 per cent returns. We are striving through this project to have the grower save his own seed whenever possible. This includes sweet corn, spinach seed, muskmelon seed, eggplant seed, tomato seed.

For the early production of crops, such as eggplant, tomato, pepper, cabbage and celery, it is necessary to grow the plant in a protected bed, such as a coldframe, hotbed, sashhouse, or small greenhouse, then transplant it into the field as early in the spring as possible. The grower realizes that the early marketing of his crop brings larger returns, and, therefore, plant-growing structures are being erected more and more every year. Blueprints of the open flue-heated hotbed have been made available by the extension service for the last 4 years, and have been used particularly for growing sweet potato plants. Another factor which bears directly on this sashhouse and greenhouse construction is use of veneer bands for the growing of early melons, cucumbers, eggplants and peppers in south Jersey.

Veneer Bands

This was one of the most popular projects the past season, due to the results secured at the experiment station the previous year. In practically all the counties melons were set in veneer bands. The results secured were very good where these melons were grown under greenhouse or sashhouse conditions, but where they were placed in coldframes or hotbeds where temperature and moisture could not be so easily controlled, they did not give the results to be desired.

Transplanting of Plants

Demonstrations were conducted in Cumberland and Salem Counties on the canhouse tomato crop. Plants for these demonstrations were secured from growers making a speciality of plant growing. At the time of setting into the field, the transplanted plants were sold to the growers in certain lot numbers to be compared with their own plants grown at home. The general result in Salem County, as reported by the cooperators, was that they favored the potted or transplanted plants, which yield anywhere from 30 per cent to 100 per cent more than the ordinary field-grown plant. Results secured this year were identical with those secured in previous years, from demonstrations conducted in Camden and Burlington Counties. As a result of these demonstrations, a larger number of growers will purchase their plants rather than try to raise them themselves. Results secured on 3 demonstration farms are as follows:

	Potted Plants Tons Per Acre	Field Grown Tons Per Acre
Farm No. 1	10.3	6.3
Farm No. 2	8.2	4.6
Farm No. 3	12.5	9.1

The Use of Selected Seed Tomato

Stock seed of the Greater Baltimore tomato was secured for this work and placed in the hands of commercial plant growers. The idea of this demonstration was to sell enough plants to the growers to plant 2 acres, which were to be compared with his regular planted field, in order that visible results might be seen by the cooperator. In Salem County these plants went to approximately 25 cooperators, and in Cumberland to approximately 35 cooperators.

Plant-Growing Structures

There is a great demand over the state for plant-growing structures for the early planting of vegetable plants. A few years ago, as previously stated, blue prints were sold to the growers in reference to an open flue-heated hotbed. The call now is for the glass-covered bed or sashhouse, or small greenhouse, and much time has been spent with growers in the discussion of this project and in laying out the details of construction. An illustrated bulletin dealing with plant-growing structures is now in the making, and will probably be out by December 1 of this year.

Melon Blight Control

The past year's work on melon blight was concentrated in south Jersey, particularly in Cape May, Camden and Ocean Counties. One cooperator sprayed 4 acres. The records of this demonstration show that over $1,800 worth of melons were sold from the field, besides a

quantity of seed being saved. His vines held up until the fruit was practically all picked, while his neighbor's vines, which were not sprayed, held up only about 10 days. Similar results were secured on another demonstration in Cape May County, where 3 acres of melons were sprayed. In this case the entire field was sprayed and a check left on an adjoining field of a neighbor just across the road. The results were so satisfactory that both of these cooperators have purchased sprayers for the 1924 season. In the Ocean County community three new sprayers have been purchased by local growers. In this community, also, four growers have gone in together and formed a spray ring. With sprayers located now in practically all of the melon area, the men purchasing and operating sprayers can be taken on as cooperators. Meetings were held to show the results of spraying.

Celery Blight Control

In Bergen and Passaic Counties the spraying of celery has been carried on for 3 years. Three years ago one sprayer was located in the Richfield section of Passaic County. As a result of the first year's demonstrations, 10 new sprayers were bought in the second year and the number has been steadily increasing. Our demonstrations showed an increase in yield of approximately $500.00 to the acre, and in two cases it meant the saving of the crop from the ravages of the late blight.

Eggplant Wilt Control

This work is carried on mainly in three counties, Salem, Gloucester and southern Middlesex Counties, where the eggplant industry is more or less highly developed. These demonstrations deal more particularly with the saving of seed from disease-free plants. An average control of these demonstrations showed that 25 per cent control was effected.

Cabbage Blackleg and Black Rot Control

In Bergen, Passaic, Camden and Cumberland Counties cabbage and cauliflower seed were sterilized for blackleg control. The hot-water treatment as recommended by the United States Department of Agriculture was used. This method includes the soaking of the cabbage seed for 30 minutes in water at a temperature of 122°. In Camden and Cumberland Counties very good results have been secured. However, in Bergen and Passaic Counties a certain percentage of the seed was killed. Some of this seed, which was sterilized, was sent to Dr. Martin, plant pathologist, to test for the blackleg organism. None of the seed, however, showed any signs or symptoms of the organism.

Insect Control

It takes very little time to demonstrate to the growers that the use of nicotine dust for the control of aphis on all vegetable crops has

been proved satisfactory. Demonstrations have been conducted in Burlington County for the control of pea aphis. Three power dusters of different makes were present to make applications. On the larger varieties of peas a control of about 86 per cent was effected, while on the smaller types, such as the Little Marvel, a 95 per cent control was secured. Demonstrations were also conducted with very good results to govern the control of this insect on various vegetables, such as the cucumber, cantaloupe, farver bean, lima bean, cabbage, cauliflower and spinach. In the case of the striped cucumber beetle the specialist made a cone measuring about 20 inches in diameter. This cone was connected directly with a Vermorel knapsack duster. In going through the field the cone is placed over each individual hill and one or two puffs made with the duster. These aphis control demonstrations will be conducted until practically every grower in the state will understand how to kill or to control the aphis and save the crop against these infestations.

Variety Standardization

These demonstrations include the trying out of new and improved varieties or varieties better suited or better adapted to certain local conditions. During the past year demonstrations were conducted on melons, tomatoes, peppers, eggplant, late cabbage and sweet corn. Thirty-two strains of Stone tomato seed were secured from various sources covering the entire United States. This seed was planted by County Agent Crissey in Salem County on the same day under identical conditions. When the plants were ready to set out into the field two cooperators were secured, one in the immediate vicinity of Hancock's Bridge and the other in the southeastern part of the county. At the time of heaviest picking a demonstration meeting was called on the Hancock's Bridge plot. In going over these blocks at the time of the demonstration, it was unanimously decided by the growers present that the strains in block No. 18, the seed of which was secured from the C. C. Hart Seed Company, Weathersfield, Connecticut, were far superior to any other. Practically all the vines were heavily covered with fruit, which was large, oval and characteristic of Stone type. One of the local cannery men had some of the best strains canned in his factory. Later in the winter, when the cans were opened, the tomatoes in No. 18 showed up far superior to any others. As a result of this demonstration there were 138 pounds of this strain of tomatoes brought into Salem County, the majority of which was purchased by the canhouse and distributed among the growers.

From the results secured from 4 years' tests with various types of muskmelons, it was decided by the growers of the state that the two melons which could be standardized by the State of New Jersey were the early Knight for the early variety and Hearts of Gold for the main crop. There are growers, however, who will keep on growing the Jenny Lind and the Fordhook, which are quite popular on some local markets, as well as on the Philadelphia market.

Garden Machinery Demonstration for Vegetable Growers

As a result of inquiries from vegetable growers throughout the state, the specialist decided to conduct a series of machinery demonstrations covering the entire state. Plans were laid in the fall of 1923, when a few of the machinery companies were approached and their cooperation secured. During January and February the demonstration areas were plotted and cooperators secured in the various counties. These plots were centrally located, in order that they would be accessible to the largest number of growers. The location of these blocks, together with the attendance, is as follows:

April 21,	Monday	Atlantic County	400
April 22,	Tuesday	Cumberland County	175
April 23,	Wednesday	Gloucester County	800
April 24,	Thursday	Burlington County	600
April 25,	Friday	Monmouth County	500
April 26,	Saturday	Passaic County	500

Commercial concerns manufacturing garden tractors, cultivators, seeders, planters, fertilizer distributors, irrigation machinery, tying and bunching machines, packages, sprayers, dusters and materials of all kinds important to vegetable growers, were interested in the proposition. During the first week in April the ground on all these plots had been put in good condition, in order that the specialist might sow rye, spraying the rows from 14 to 16 inches apart for the small tractors and from 24 to 30 inches apart for the larger tractors.

One-Horse Sprayer. During the year 1923 the vegetable gardening specialist constructed a sprayer which would spray practically all vegetable crops. Many inquiries had been received in reference to a 1-horse 50-gallon machine which would spray melons, as well as tomatoes, peppers and celery. The standard 1-horse sprayer commonly used has the horse walk between the wheels. In other words, *the horse walks between the inside row centers and the wheel track* between the other row. With the new 1-horse sprayer, the horse walks directly in front of a large drive wheel, which is always centered between the rows. The standard 1-horse sprayer cannot be used in the spraying of cucumbers and melons or eggplant and tomatoes, due to the fact that, in rows over 4½ feet apart, the horse would necessarily have to walk on the row in order that the wheels track between the row centers. This new 1-horse traction sprayer gave very good results on potatoes, muskmelons, cucumbers, beans, eggplant and celery. There are a few changes which will be made, although the principles involved have worked out very well, and can be used on practically all crops. It is especially adaptable to the smaller grower.

Poultry Extension Work

A definite program of extension work in poultry has been carried out during the past year in 19 counties of New Jersey, with the object of bringing to the attention of all interested the newer and better methods in poultry management.

For the first 6 months two specialists were engaged in this work, but since January the work has been carried on by one man.

In the counties where work is being carried on there are local poultry organizations and agencies which act as a means for carrying out to a successful end the program of work. These agencies are as follows:

1. County poultry project committee
2. Local poultry associations
3. County record and demonstration clubs
4. Boys' and girls' clubs

In 16 counties of the state a program of work for the coming year was outlined by the poultry project committee, consisting of a representative from each community interested in poultry keeping, the county agricultural workers, and the poultry specialist. In the other counties of the state only a minor program is being followed, which was outlined by the poultry specialist, the county agent, and, in some instances, a few poultrymen. In these counties only certain phases, such as culling, feeding and housing practices are being demonstrated.

In the counties where the poultry program is one of the major projects of the agricultural program, local poultry associations have been formed, including in the membership all those that are interested and engaged in poultry keeping on a large scale. In some counties there is only one association, while in others there are as many as five, depending upon the interest. All the associations hold monthly meetings. The educational committee of these associations meets once a year, usually in the fall, and outlines, with the assistance of the county agent and the poultry specialist, an educational program consisting of speakers of county, state and nation-wide reputation. Along with this educational program there are usually held timely demonstrations.

In 12 counties of the state there are poultry clubs that meet once a month to discuss the records kept on their poultry. These records are used for comparison among the members of the club and for state comparison by the poultry specialist. At each of the monthly club meetings a regular program is followed, giving timely information to the members. The membership of these clubs is made up of one representative from each community in the county. Of course, in some counties it is impossible to have every community represented. It is the hope that the ultimate result of this work will be a cooperator in each community in the state keeping accurate records, and demonstrating in the respective communities the poultry practices recommended by this office.

In 9 counties, where club work is supervised by a county club agent, boys' and girls' clubs have been formed and are following a definite outline of work. Some of our best poultry demonstrations to show what can be done with the farm flocks in rural communities are through this type of work.

This unified program of work and organization in the counties, plus the local poultry associations that make up the membership of the State Poultry Association, is the machinery for carrying on poultry extension work in New Jersey.

CLOTHING EXTENSION WORK

The ultimate goal for extension clothing in New Jersey is:

1. To teach our women to handle their clothing problems with the least expenditure of vitality and time.
2. To teach that all clothing should be healthful as well as beautiful.
3. To teach fundamental principles of design, color and appropriateness so that they may know what to wear and how to wear it.

Because extension teaching is conducted to a large extent by the assistance of local leaders, it has seemed wise to arrange all clothing in a series of units, each one complete in itself, but still bearing a definite relation to the whole. This gives a definiteness to the work that makes it possible for the leader to handle it without concerning herself as to details. It means, too, that in a limited amount of time (a day of 5 or 6 hours) the busy woman has completed a piece of work—a hat or a pattern—which is useful at once. Also, the principles involved in carrying out this single unit can be applied to similar problems at home.

In view of the fact that, in 1923, clothing claimed an undue amount of the home demonstration agent's time, it was decided to give no new units in clothing in 1923-24, except such work as was to be done in cooperation with the home management specialist in interesting women in better corsets and shoes. This gave the specialist time for training new leaders to assist in carrying on the units already prepared, and, with their help, to reach many women who had not hitherto had extension instruction in clothing. It has been interesting to note that many old leaders asked permission to observe the training of new leaders so they might feel more confident themselves.

A definite program of work was planned for 1923, and, except for a slight change in dates, it was carried out as planned.

The new phases of the clothing program call for special mention. In September, sectional demonstrations were arranged by the specialist in cooperation with the home management specialist to interest the women of New Jersey in better corsets. The educational secretary of the Gossard Company of Chicago spent 5 days in the state assisting in this piece of work. She met the home demonstration agents at the college for a day's conference, and, following this, four sectional demonstrations were given in different parts of the state. The fact that 16 of our 19 rural counties, beside the city of Paterson, were represented at these meetings, proves that the interest was widespread.

During October and November, and again in March, the specialist gave demonstrations of dress design. This method is used to stimulate an interest in permanent patterns and also to suggest to the women who have already made their patterns, new ways of using them. The specialist, using materials that are seasonable, makes several dresses

from her own patterns. These are worn by the specialist, and, as each one is shown, the manner in which the design was developed is explained quite fully. There is a chance for questions, and, until our audiences became too large, the garments were available for close inspection. At present a set of models (made by the home demonstration agents) is in each county. Mimeographed sheets giving full directions for making the designs are prepared by the specialist and are available for all who ask. These meetings also give the specialist a chance to interest the women in such phases of clothing as color, design and appropriateness.

This has been one of the most popular clothing projects. In 19 counties, in the fall of 1923, there were 2,954 present, representing 311 different communities. In the spring of 1924, eleven demonstrations brought out 2,420 women from 243 communities. That it is possible to reach 243 communities in 11 meetings means that our women have recognized the fact that they must assume part of the work in the extension job. If they were not willing to travel to a county-wide meeting, seasonal dress design could not be given, as the garments would be worn out and quite out-of-date if we visited each community. The spread of influence from these meetings is difficult to measure, but we have ample evidence that we are reaching and helping thousands.

Local leaders were instructed in taking foot imprints by means of a pedograph. Nine hundred and twenty-eight women took advantage of this service.

Work in counties not having home demonstration agents was given by the specialist. Leaders were trained for millinery. Follow-up work in these counties was carried on by one of our local leaders who had been trained by the specialist.

FOODS EXTENSION WORK

Extension teaching in foods has been confined to the following:

1. Diet of children
2. Meal planning
3. Foods budget

In every county except one, where there is a home demonstration agent, 4 meetings were conducted to give information to local leaders in regard to proper diet for children. These demonstration meetings, in most cases, were well attended, and, from the comments of the women, it is evident that teaching in this field is much needed and appreciated. One woman who thought it impossible to keep a baby on a regular schedule—feeding, bathing and resting—with the other household duties to be done, wrote as follows:

Now baby is always happy and pleasant, because his habits are all formed for him. In his baby way, he knows what to expect next and has learned to "take life as it comes to him." Vision and effort have overcome what used to be impossibilities.

Breakfast Project

One method used in foods work is to teach girls how to prepare and serve a simple, appetizing breakfast. Leader training groups were held in Ocean, Cumberland and Morris Counties. This work is being conducted by the leaders with good results.

Meal Planning

Interest in the meal-planning project for adults is growing constantly. At their meeting the foods leaders declared themselves willing to do more foods work and to conduct the all-day meeting of the meal-planning project. Reports show that the leaders are taking more responsibility, thereby helping the extension program to serve more people.

The food habits in many homes have been changed much to the delight of the mother, who finds the family in better health, because they have eaten more fruit, vegetables and milk. In a few counties much stress has been placed upon the importance of using milk from tested cows.

Foods Budget

The foods budget includes the planning and planting of the garden, the canning and storage of winter products, together with the buying of staples in wholesale quantities. Less canning is being done in the home; therefore, greater stress was placed upon buying these commercial products in wholesale amounts. By having the winter's supply of stored and canned foods in the cellar the housewife will have better-planned meals with a saving of considerable time and money. Some women have agreed to keep a record of the amount of food they have on hand when the growing and preserving season is over.

One of the outstanding things accomplished in foods extension work has been to reach a group of young and overtaxed homemakers who could not be induced to take other work.

This project needs more time from the home demonstration agents. It demands a more personal type of visit and organization than other lines. However, there is marked progress in the attitude of agents and leaders. The more recent work has proved that leaders are well able and willing to cooperate in teaching better nutrition.

HOME MANAGEMENT EXTENSION WORK

I. Goals.

The goals of the home management project have been:

1. To present the extension program as a united whole, not as competitive divisions.
2. To measure successful homemaking in terms of human welfare.
3. To help homemakers develop a time and strength budget which shall give them the time for more balanced living and the vitality to use their leisure for happier homemaking—not merely for cessation of work.
4. To start a household renovation program which shall do away with hit-or-miss buying of equipment.

II. Methods.

A. Two joint projects have been carried on with each of the other specialists.

1. With clothing specialist:

a. Corsets.

This project has been the means of showing that the reason why a majority of New Jersey women have come to require the artificial support of corsets is that they have let their muscles deteriorate and their diet remain faulty, with overweight or underweight as a result. To get one's money's worth from corsets (as from all clothing) requires something more than careful selection and fitting; posture and weight must be made as nearly normal as possible. It costs to be abnormal, and that is poor management.

b. Shoes.

This project showed that only one New Jersey woman in ten can forget her feet. This is due to false standards of foot beauty; to wearing of incorrect shoes; to weakness of muscles through wrong diet, and through wrong use as well as disuse; to body weight disproportionate to the size of the feet; and to so-called "corrective devices" secured without a physician's advice.

2. With foods specialist:

a. Short-cut cookery.

The foods and home management project leaders originated the idea of making joint meetings of their training groups. This made a unit of meal planning and home management and demonstrated how much more effectively both may be carried on by means of a few fundamental principles rather than by a large number of rules and recipes.

b. Photograph tour.

Thanks to the help of the Washington office and the cooperation of 4 counties and 1 city, a series of 74 photographs were secured which tell the story of the work done in foods and home management. These pictures are being used by other states as well as New Jersey.

B. The smooth running of the human machine has again been made the basis of smooth-running household machinery. Out of the homemaker's daily tasks an automatic "daily dozen" has been evolved.

C. The time-and-strength budget has been used to help women to live efficiently on 24 hours a day and to recognize as unthrifty the hit-or-miss spending of strength.

D. The "repair in time" that save at least nine avoidable motions and irritations has been stressed as the first step in a long-time program for re-arranging and re-equipping the home workshop.

E. A junior home management project has been started, with special emphasis on preparation and planning for any job selected.

III. Results.

One county fair has accepted the plan of including the human family in its contests and premium list, since "Better Babies" are impossible without "Fitter Families".

Every county reports an increased number of home demonstrations.

Every county sends instances like the following, of how the work is being passed on:

A home management project leader, walking (by preference) up the stairs of a department store, saw an overweight colored sister toiling on ahead. "Excuse me," said the exponent of easier stair-climbing, "but you seem to be making as hard work of that as I used to. May I show you an easier way?" Later the two met on an upper floor. "I want to thank you," said the colored woman, "for the biggest help anyone has given me in many a day."

The result that will go farthest in helping the home management project to reach its goals is the securing of a state project leader who has proved her faith in it and pledged it her support.

It is very gratifying to note the extent to which community leaders have passed on this work. Often the newer projects suffer because the leaders do not feel sure of themselves in them.

The home management project is largely responsible for stimulating the interest, making the joint projects possible. The way the women of the state have, of their own accord, taken hold of and followed up the work in "Corsets as Affecting Posture" and "Shoes in Relation to the Foot as Equipment," means that the specialists must include more along these lines another year.

AGRICULTURAL ECONOMICS EXTENSION WORK

Farm management extension work, which was organized July 1, 1923, has produced encouraging results among county extension workers, farmers and businessmen. County agricultural agents, on the whole, are appreciating this type of work, which brings them more intimately in touch with the farming practices and financial conditions of many of their farmers. One agent recently said, "I knew these farmers who are now keeping accounts and have worked with several of them in certain crop demonstrations on their farms for the past 5 years, but the farm record demonstration work has brought me in closer touch with these men and has given me a clearer insight into their actual business practices and affairs than anything which I have yet done."

Farmers themselves have spoken highly of the work, and are now beginning to see the importance of keeping track of income and expense. In fact, at three or four of the farm account schools several

men virtually said, "If I don't keep the book, making out the inventory and financial statement of my own farm business has been worth considerable to me."

Business men, especially bankers who have a large number of farmer patrons, feel that farm management record work is an important piece of work. Quite a few banks in New Jersey now require their patrons who want to get a loan from the bank to file a financial statement. Farm record work helps the farmer and the banker to render such a statement.

Farm Account Schools

Farm account schools have been held during the past year in 15 counties of the state. The schools lasted from 10:00 A. M. until 4:00 P. M. in most cases.

Each man attending the school was shown how to make out an inventory of his farm property, both personal and real. He was then shown how to make out a financial statement as of date. He was then shown how to open up his active accounts and how to keep these accounts. Personal attention to each man's book was given by the specialist. The type of book used was a stock journal which the specialist turned into a ledger. A suggested inventory list covering property items on New Jersey farms was furnished by the specialist on mimeographed sheets of paper for each man.

The dates of farm account schools with the attendance follows:

DATES OF FARM ACCOUNT SCHOOLS—1924

County	*Attendance*
Atlantic, January 23	11
Ocean, January 24	5
Monmouth, January 25	20
Warren, January 11	5
Sussex, January 19	11
Morris, January 8,	5
Bergen, January 9	4
Mercer, January 29	7
Burlington, January 30	3
Middlesex, February 1	10
Somerset, February 6	3
Salem, February 7	5
Cumberland, February 8	7
Gloucester, February 14	7
Camden, February 15	7
Total	110

Regular monthly visits are made to all of the 110 adult farm account demonstrators, either by the county agent or specialist. The specialist spends one day each month in the counties and visits as many men as possible on their own farms with the county agent. It is usually possible to visit from 5 to 7 men in a day, go over their books with them and discuss with them any farm management prob-

lems which may come up. These questions relate to the whole field of farming, from purebred sires, T. B. testing, strains of seed, labor, barn plans, water, finance, electricity and tractor, to short and long courses at the college. It is hoped that by this close follow-up the men will not only finish their year's work, but that many of them will continue to keep the record of their expenses and income, and that results will be so satisfactory that these records can be used for farm management work in the several counties. It is also hoped that many of the men who are getting the training may become farm management demonstration leaders in their various communities, and that they will volunteer their leadership in helping a larger group to keep records next year.

Farm Account Clubs

In Ocean County a farm account club with farm boys around 16 to 18 years of age has been organized. The club agent meets with the club each month, and the specialist meets with the group once every two months. The Ocean County Club first met in a group, and, like the adults, were shown how to take an inventory, and second, how to keep active farm accounts. The club is coming along quite satisfactorily, and is demonstrating thus far that there is a great opportunity for this type of work among juniors on New Jersey farms.

Farm Account Analysis Schools

Plans for this project call for farm account analysis schools in November and December, to be held in the same 15 counties where farm account schools were held in January and February. At the analysis schools each farm account demonstrator will bring his account book and will be shown how to analyze his own records for the year. This should prove to be one of the most valuable chapters in the year's work. Many men have kept a record of their business, but few have known just how to interpret and use the records to advantage in their own business. The men will also be shown how to make out a profit and loss sheet, and how to take an inventory at the beginning of 1925.

A survey of 26 dairy farms in Warren County was made to get information on the kind of feeds used, costs of feed, and profits or losses made. The county agent and dairy specialist made a similar survey on about 25 other farms. The material was analyzed and each farmer received a special letter on feeding from the county agent. The data will also be used in connection with the alfalfa campaign in the county and at community meetings.

Report of the Department of Agronomy

George W. Musgrave

INTRODUCTION

The present year has seen a very considerable development in the organization and work of this department. The separation of the departments of agronomy and argicultural economics as distinct and separate departments is in keeping with the organization in other institutions, since the subject-matter in recent years has developed in entirely different directions. It has permitted a more efficient organization of this department. Further development has been possible through the addition to the staff of Mr. H. B. Sprague as assistant in agronomy, effective July 1, 1923. The research work has been very greatly strengthened also by the development on the college farm of the series of plots which, during the present year, have been brought to a point where work with all of the major crops is now possible. In the development of these experimental plots much attention has been given to the planning of them so that the most reliable results may be obtained. The technique of agronomic research has in recent years moved rapidly forward, and it is the aim of the department to use the most modern methods, not only as to field methods as related to plot arrangement, method of harvesting, but also in the analysis and interpretation of the data. With the present limitation in size of staff, it is not possible to conduct all phases of the research in as much detail as may be desired. The vast average and total value of the field crops of this state, and the large number of growers whose success is dependent to a considerable extent upon their methods of handling these basic crops, merits a much larger attention than the present small staff employed on part time for this work can devote to it.

During the present fiscal year the principal lines of work carried on were as follows:

1. Size of potato seed piece and rate of planting test—continuation of previous work on this project.
2. Potato improvement—continuation of the hill and tuber unit work.
3. Alfalfa seed source test.
4. Adaptation and yield tests of varieties of the following crops—wheat, oats, timothy, soybeans, red clover. Also comparison of oats and barley in the rotation, as to yield.
   Comparison of sudan grass, millet, soybeans for hay purposes.
5. Corn-breeding project—inbreeding and selection within self-fertilized lines.
6. Soybean survey.
7. Miscellaneous.

Size of Potato Seed Piece. Size of potato seed piece project was planted in cooperation with farmers in the vicinity of Dayton and Farmingdale. The layout of these plots and the numbers of stems per seed piece of various sizes were indicated in the previous report. The yields from the Farmingdale plots are given in table 1.

TABLE 1

Size of Seed Piece Project, Farmingdale, N. J.

ROW	Seed Piece	Average per plot (5 plots 100 by 2.75 ft.)
	ounces	*pounds*
2	.5	54 ± 7.4163
4	1.0	65 ± 4.8736
6	1.5	66 ± 3.0088
8	2.0	72.1 ± 3.9126
10	.5	48.8 ± 3.4567
12	1.0	61.4 ± 4.9649
14	1.5	68.7 ± 4.4120
16	2.0	67.6 ± 3.4180
18	.5	54.6 ± 2.2607
20	1.0	61.8 ± 2.4379
22	1.5	70.2 ± 3.2881
24	2.0	71 ± 3.5225

Summary

Seed Piece	Average per Plot (15 plots 100 by 2.75 ft.)	Average per Acre from 15 plots each size	Amount of Seed Used	Yield After Subtracting Seed	Seconds and Culls of Total Weight
oz.	*pounds*	*bu.*	*bu.*	*bu.*	*per cent*
.5	52.47 ± 2.7863	138.52 ± 7.3558	8.25	130.27	10.256
1.0	62.766 ± 2.3122	165.70 ± 6.1042	16.50	149.20	10.679
1.5	68.3 ± 1.9604	180.31 ± 5.1754	24.75	155.56	10.683
2	70.23 ± 2.1571	185.4 ± 5.6947	33.00	152.4	17.746

A comparison of the yields of the check plots in this test indicated also that there is a depression of the yield of these check rows by the adjoining high-yielding plot rows. This is indicated in tables 2 and 3.

Comparing the average yields of the check rows with that of the adjoining plot rows, a correlation coefficient of .6526±.191 further

indicates that the check-row yields have been depressed by adjoining plot rows where such yields are high, and gives further evidence that competition exists at the 33-inch spacing of rows used in this test. Reliable field tests, therefore, cannot be expected from single-row plots unprotected by buffer rows, and such competition very probably

TABLE 2

Average Yields of Check Rows and Adjoining Plot Rows

Plot Rows	Yields* per 100 feet	Check Rows	Yields* per 100 feet
ounces	*pounds*	*ounces*	*pounds*
0.5 and 1	57.62 ± 2.351	Between .5 and 1	67.53 ± 2.854
1 and 1.5	65.53 ± 1.886	Between 1 and 1.5	65.50 ± 4.182
1.5 and 2	69.27 ± 1.927	Between 1.5 and 2	60.53 ± 2.068

*Harvest weights average of fifteen 100-foot blocks of row each case.

TABLE 3

Comparative Yields of Check Rows and Adjoining Plot Rows

Plot No.	Size of Seed Piece	Row Yield per 500-foot row	Check Yield per 500-foot row	Plot No.	Size of Seed Piece	Row Yield per 500-foot row	Average Yields Rows Adjoining Check plots per 500-foot row
	oz.	*pounds*	*pounds*		*oz.*	*pounds*	*pounds*
2	0.5	270.0	356.0	4	1.0	325.5	297.75
10	0.5	244.0	348.0	12	1.0	307.0	275.50
18	0.5	273.0	309.0	20	1.0	309.0	291.00
4	1.0	325.5	333.0	6	1.5	330.0	327.75
12	1.0	307.0	337.5	14	1.5	343.5	325.25
20	1.0	309.0	312.0	22	1.5	351.0	330.00
6	1.5	330.0	294.0	8	2.0	360.5	345.25
14	1.5	343.5	323.0	16	2.0	338.0	340.75
22	1.5	351.0	291.0	24	2.0	355.0	353.00
Average			322.61				320.69

accounts, at least, to some extent, for many of the discrepancies which have occurred in the results obtained in cooperative and demonstration seed source and other tests.

The comparative cost of seed and the value of the crop for the years 1913-21, inclusive, and the application of these prices to the yields obtained in the above test, are given in table 4.

This indicates that, the prices prevailing as they have for the period indicated above, the 1½-ounce seed piece, while giving a larger gross and net yield, does not give a larger return above the 1-ounce seed piece. When there is a greater spread between the two prices than that indicated above, the larger size of seed piece may be profitable.

TABLE 4

Potatoes

Central Jersey—Mostly Giants

YEAR	Seed Cost per 165 pounds	Price Received per Bushel
1913	$2.25	$0.57
1914	2.75	.51
1915	2.00	.33
1916	2.50	.91
1917	3.70	.86
1918	6.25	1.16
1919	6.00	1.25
1920	6.75	.78
1921	5.00	1.06
1922	(4.75)	....
Total (9)	$37.20	$7.43
Average (9)	4.13	.826
Average per bushel	1.50	....

	Seed Cost per Acre	Value of Crop per Acre	Value Above Seed Cost
oz.			
0.5	$12.375	$114.42	$102.05
1.0	24.75	136.87	112.12
1.5	37.125	148.94	111.82
2.0	49.50	153.14	103.64

The yields obtained from the Dayton experiment are given in table 5. As previously indicated, the plots in this test were not as large as those of the Farmingdale test, nor were they protected by buffer rows. The increased gross yield with larger sizes of seed piece seems to be well established. The long-continued practice of the farmer in this section has determined, approximately, the most efficient size for normal prices prevailing for seed and crop.

A comparison of the various sizes of seed piece at planting rates, giving equivalent bushels of seed per acre, has not been made in this state, however, and on April 24, 1924, the test outlined in table 6 was planted on the same farm in Farmingdale as that reported in table 5.

TABLE 5

Yields, Dayton, N. J.

Size of Seed Piece	Yield per Row	Yield per Acre	
oz.	*pounds*	*bu.*	
0.5	82.5	52.86	Series A
1.0	137.5	88.10	
1.5	198.5	127.19	
2.0	268.0	171.72	
0.5	148.0	94.83	Series B
1.0	187.0	119.82	
1.5	245.5	157.31	
2.0	228.0	146.09	
0.5	230.5	73.84	Combined Average
1.0	324.5	103.96	
1.5	444.0	142.25	
2.0	496.0	158.91	

TABLE 6

Potato Size of Seed Piece and Rate of Planting Test

Plot A	½ ounce piece	12 inches in the row
Plot B	½ ounce piece	9 inches in the row
Plot C	1 ounce piece	18 inches in the row
Plot D	½ ounce piece	7½ inches in the row
Plot E	1 ounce piece	15 inches in the row
Plot F	1½ ounce piece	22½ inches in the row
Plot G	½ ounce piece	6 inches in the row
Plot H	1 ounce piece	12 inches in the row
Plot I	1½ ounce piece	18 inches in the row
Plot J	1 ounce piece	9 inches in the row
Plot K	1½ ounce piece	13½ inches in the row
Plot L	1½ ounce piece	9 inches in the row

These plots consist of 3 rows each 125 feet in length, with 5-foot margins on each end, and are in 2 series, the second series being arranged in the reverse order from the first, which places the duplicate plots in such a manner as to give an indication of the average yield for the soil variation which occurs on this field. The number of stems per seed piece of various sizes is indicated in table 7.

TABLE 7

Average Number of Stems Per Plant from Various Sizes of Seed Piece

Size of Seed Piece	Stems per 100 Plants	Stems per Plant	Standard Deviation and ProbableError
oz.			
0.5	125	1.25	.433 ± .020651
1.0	153	1.53	.6618 ± .03155
1.5	202	2.02	.6432 ± .03067

POTATO IMPROVEMENT

The potato improvement project was continued from the previous year, planting the late or second crop seed in two portions, one as an early or main crop, and the second portion was planted as late or second croppers for multiplication for further testing. The yields from the selected units, which were planted April 25 and harvested August 8, 1923, are given in table 8.

TABLE 8

Yields of Selected Potato Units

UNIT	Yield	UNIT	Yield
Row 1	*bushels*	*Row 4*	*bushels*
6	111.09	"A"	101.82
19	97.37	"B"	99.07
20	115.53	"C"	106.97
21	147.18	1	142.63
		2	113.89
Row 2		11	85.69
49	76.80	12	78.23
50	95.34	48	129.80
64	21.94	68	85.91
66	98.41	70	80.97
		83	118.82
Row 3		84	129.59
"D"	67.91	86	109.06
"E"	96.00		
"F"	116.90		
"G"	116.90		

In November, 27½ hampers of selected seed from these units were put in storage. These units are those remaining after discarding all those showing weakness, disease or low yields during the 3 years of selection. Several of these have shown outstanding high yields throughout the entire year, and it is believed are worthy of trial on a field scale.

TABLE 9

Alfalfa Summary, 1923

VARIETY	Source of Seed	Date of Second Cutting*	Shrinkage	Acre Yield Cured Hay	Average Number Plants per 12 square feet†	Gross Weight per plot Average of 20 frames
			per cent	*tons*		*ounces*
Weedless Dry Land....	Alfalfa Growers' Union, Atwood, Kansas	7-24	73.2	.62	76	20.50 ± .7031
Common	J. L. Maxson, Buffalo Gap, S. Dakota	7-24	74.2	.81	74	25.50 ± .6218
Common	Thomas O'Hanlon, Chinook, Montana	7-25	75.6	.63	84	22.45 ± .4830
Common	Yellowstone Valley Seed Growers' Assoc., Miles City, Montana...	7-26	90.9	.73	80	21.95 ± .4805
Common	Barteldes Seed Co., Lawrence, Kansas	7-30	77.3	.85	84	32.30 ± .8405
Idaho Grimm	G. L. F. Exchange, Syracuse, N. Y.	7-30	75.0	.86	84	30.55 ± .7571
Certified Hairy Peruvian,	Farm Bureau Exchange, Yuma, Arizona	7-30	77.3	.50	42	19.40 ± 1.035
Grimm	Yellowstone Valley Seed Growers' Assoc., Montana	7-26	72.6	.90	94	27.80 ± .3998

*All ready to harvest 7-24—press of work delayed harvest.

†Five sections of 12 square feet, each were counted May 15, 1924.

TABLE 10

Wheat Yields, College Farm, 1923

Plot	VARIETY	Total Weight Grain and Straw Five Blocks	Weight of Grain per Plot	Straw per Plot	Straw per Acre	Yield per Acre of 60 lbs.	Weight per Bushel
		ounces	*ounces*	*ounces*	*pounds*	*bushels*	*pounds*
17 N. E.	Pennsylvania 44	181.50	54.0000	127.5000	5785.3125	41.24 ± 1.565	57.62
S. W.	Dawson's Golden Chaff...	192.75	64.1250	128.6250	5836.3593	47.197 ± 1.328	58.00
16 N. E.	Fulcaster	166.25	54.8750	111.3750	5053.6406	41.182 ± .857	58.50
S. W.	Currell's	155.75	51.2500	104.5000	4741.6875	38.197 ± .899	55.12
15 N. E.	Leap's Prolific	185.25	65.5000	119.7500	5433.6562	49.291 ± 1.566	58.12
S. W.	Ohio 127	193.00	68.0000	125.0000	5671.8750	50.389 ± 1.024	59.75
14 N. E.	Fultz	176.25	64.6250	111.6250	5064.9843	49.102 ± 2.377	58.62
S. W.	Kanred	156.00	54.5000	101.5000	4605.5625	40.971 ± 1.584	59.12
13 N. E.	Gladden	159.00	52.0000	107.0000	4855.1250	38.386 ± .819	59.00
S. W.	Pennsylvania 44	181.75	61.5625	120.1875	5453.5078	46.413 ± 1.236	59.00
12 N. E.	Harvest King	170.75	63.4375	107.3125	4869.3046	47.76 ± 1.318	58.50
S. W.	Fulcaster	165.25	58.1875	107.0625	4857.9609	43.748 ± 1.915	60.00
11 N. E.	Dawson's Golden Chaff...	187.75	76.1875	111.5625	5062.1484	56.505 ± 2.105	59.00
S. W.	Leap's Prolific	171.50	68.5000	103.0000	4673.6250	52.362 ± 1.627	59.00
10 N. E.	Currell's	167.50	64.6875	102.8124	4665.1171	48.969 ± 1.536	58.75
S. W.	Fultz	145.50	57.0625	88.4375	4012.8515	42.967 ± .943	58.25
9 N. E.	Ohio 127	165.00	63.3750	101.6250	4611.2343	46.877 ± 1.625	60.00
S. W.	Gladden	163.25	56.5000	106.7500	4843.7812	42.911 ± .971	60.00
8 N. E.	Kanred	152.50	56.5625	95.9375	4353.1640	42.684 ± 1.160	57.50
S. W.	Harvest King	149.50	60.8125	88.6875	4024.1953	45.834 ± .838	59.15

Alfalfa Strains

Harvest weights on the second cutting of each of the alfalfa plots were made on the dates indicated in table 9. The per cent of shrinkage and the yield of cured hay per acre is also indicated. Little difference in yield is to be noted, excepting as between the Arizona seed and the various sources from Kansas and northward. The plots from Arizona seed have winter killed, and the stand in April, 1924, has been reduced to approximately one-half that of the other plots, as indicated in the count on average number of plants per 12 square feet.

These plots were plowed under in May, 1924, preparatory to making a new summer seeding of these and other sources for further testing.

ADAPTATION AND YIELD TESTS

Yields in the wheat variety tests were obtained by harvesting 5 frames (12 square feet each) placed at random on each of the plots and their duplicates. The yields are given in table 10. In this test Dawson's Golden Chaff and Leap's Prolific gave the highest yields, while Gladden and Kanred produced the lowest. These relative yields were also obtained in all of the demonstration tests conducted by the extension specialist in cooperation with the county agents, with the exception of one county, where Gladden gave the larger yield. It is to be noted in this connection that in this county test soil conditions were far from uniform. The variety Pennsylvania 44 in the previous year produced a relatively larger yield. Leap's Prolific and Dawson's Golden Chaff, however, have indicated their high-yielding ability in many of the cooperative tests in the various counties.

TABLE 11

Wheat Summary

VARIETY	Straw per Acre	Grain per Acre	Test Weight per Bushel
	pounds	*bushels*	*pounds*
Dawson's Golden Chaff	5959.05	51.851 ± 1.571*	58.50
Leap's Prolific	5030.95	50.827 ± 1.072	58.56
Ohio 127	5141.45	48.633 ± .987	59.88
Harvest King	4446.25	46.797 ± .766	58.83
Fultz	4527.55	46.034 ± 1.417	58.44
Pennsylvania 44	5619.45	43.827 ± 1.104	58.31
Currell's Prolific	4703.40	43.583 ± 1.472	56.94
Fulcaster	4965.60	42.465 ± 1.059	59.25
Kanred	4478.45	41.827 ± .963	58.31
Gladden	4849.70	40.648 ± 1.115	59.50

*P. E.—probable error, computed from formula $P. E. = .6745\sqrt{\frac{Ed^2}{n\ (n-1)}}$

(Letter "E" in formula equivalent to Greek letter "Sigma.")

TABLE 12
Oats and Barley Variety Test

Plot No.	VARIETY	Date of Heading	Average Height	Date of Ripening	Total Yield per Plot of 10 sq. ft. sections	Grain Yield per Plot of 10 sections 12 sq. ft.	Straw Yield per Plot of 10 sections 12 sq. ft.
			in.		gm.	gm.	gm.
17D N. E.	Swedish Select, C. I. 134	6-25	29	8-6	4709	610	4099
S. W.	Iowar, C. I. 847	6-24	23	7-16	3158	525	2633
16D N. E.	Silvermine, C. I. 659	6-25	31	8-6	4871	665	4206
S. W.	Cornellian, Cornell	6-25	35	8-6	6724	530	6194
15D N. E.	Kherson, C. I. 459	6-21	26	7-16	3436	1220	2216
S. W.	Manchuria, C. I. 863	6-23	23	7-16	3481	1435	2046
14D N. E.	Lincoln, C. I. 738	6-25	31	8-6	4598	740	3858
S. W.	Hannchen, C. I. 531	6-28	26	7-21	2910	1060	1850
13D N. E.	Fulghum, C. I. 708	6-23	22	8-6	3880	905	2975
S. W.	Featherston*	6-21	24	7-16	3330	1535	1795
12D N. E.	Iowar, C. I. 847	6-24	22	7-16	2972	855	2117
S. W.	Swedish Select, C. I. 134	6-25	31	8-6	4545	820	3725
11D N. E.	Cornellian, Cornell	6-25	34	8-6	4422	920	3502
S. W.	Silvermine, C. I. 659	6-25	27	8-6	4379	695	3684
10D N. E.	Hannchen, C. I. 531	6-28	22	7-21	2646	1120	1526
S. W.	Kherson, C. I. 459	6-21	22	7-16	2688	1145	1543
9D N. E.	Manchuria, C. I. 863	6-23	23	7-16	2749	1325	1424
S. W.	Lincoln, C. I. 738	6-25	27	8-6	4058	910	3148
8D N. E.	Featherston*	6-21	22	7-16	3051	1510	1541
S. W.	Fulghum, C. I. 708	6-23	23	8-6	3768	850	2918

*Smutty

OATS AND BARLEY VARIETY TEST

The varieties included in the oats and barley variety test and the yields obtained are given in table 12. These plots were seeded April 21, by hand, broadcast in two directions, covered by raking by hand, and the seedbed compacted by the use of the cultipacker. The fertilizer consisted of 400 pounds per acre of 16 per cent acid phosphate applied broadcast. The plots consisted of two $^{1}/_{40}$-acre plots of each variety arranged in such a manner as to give fair distribution over what soil variation exists. Yield determinations were made by the use of a harvesting frame covering 12 square feet, obtaining 5 blocks from each plot or 10 blocks for each variety. These blocks were located in a checkerboard fashion to cover such variation within the plot as might prevail.

The yields of threshed grain with the test weights per bushel are given in table 13.

TABLE 13

Oats and Barley Variety Test

Plot No.	VARIETY	Test Weight per Bushel of Grain	Grain Yields per Acre (cleaned) *	Straw Yields per Acre	Yield per Frame Before Cleaning
		pounds	*bu.*	*pounds*	*gm.*
17 D N. E.	Swedish Select	16.5	15.3	3280.3	76.90 ± 3.09
17 D S. W.	Iowar	21.0	13.1	2107.1	63.53 ± 3.36
16 D N. E.	Silvermine	20.5	16.6	3365.9	89.30 ± 4.67
16 D S. W.	Cornellian	20.0	13.3	4956.9	76.50 ± 2.64
15 D N. E.	Kherson	22.5	30.5	1773.4	132.9 ± 5.99
15 D S. W.	Manchuria	45.0	23.9	1637.3	153.01 ± 6.62
14 D N. E.	Lincoln	17.5	18.5	3087.4	85.80 ± 3.87
14 D S. W.	Hannchen	47.0	17.7	1480.5	111.32 ± 4.56
13 D N. E.	Fulghum	19.5	22.6	2380.8	121.3 ± 4.01
13 D S. W.	Featherston	45.0	25.6	1436.5	161.18 ± 4.73
12 D N. E.	Iowar	21.0	21.4	1694.1	94.96 ± 5.78
12 D S. W.	Swedish Select	17.5	20.4	2981.0	94.60 ± 1.9
11 D N. E.	Cornellian	21.5	23.0	2802.5	108.30 ± 5.43
11 D S. W.	Silvermine	19.5	17.4	2948.2	87.2 ± 4.65
10 D N. E.	Hannchen	48.0	18.7	1221.2	116.76 ± 4.71
10 D S. W.	Kherson	21.0	28.6	1234.8	118.44 ± 4.43
9 D N. E.	Manchuria	45.0	22.1	1139.5	139.29 ± 6.23
9 D S. W.	Lincoln	19.0	22.8	2519.8	100.4 ± 5.11
8 D N. E.	Featherston	44.5	25.2	1233.2	158.99 ± 6.78
8 D S. W.	Fulghum	19.0	21.3	2335.2	110.3 ± 3.35

*Oats 32 lbs. per bushel
Barley 48 lbs. per bushel

TABLE 14

Summary—Oats and Barley

VARIETY	Date of Heading	Date of Ripening	Average Height	Grain Yield*	Test Weight per Bushel	Straw Yield
			in.	*bu.*	*lbs.*	*bu.*
Swedish Select, C. I. 134..	6-25	8-6	30.0	17.88	17.00	3130.6
Iowar, C. I. 847........	6-24	7-16	22.5	17.26	21.00	1900.6
Silvermine, C. I. 659.....	6-25	8-6	29.0	17.01	20.00	3157.1
Cornellian	6-25	8-6	34.5	18.13	20.75	3879.7
Kherson, C. I. 459.......	6-21	7-16	24.0	29.56	21.75	1504.5
Lincoln, C. I. 738.......	6-25	8-6	29.0	20.63	18.25	2803.3
Fulghum, C. I. 708......	6-23	8-6	22.5	21.93	18.75	2358.4
Barley						
Featherston	6-21	7-16	23.0	25.38	44.75	1334.8
Manchuria, C. I. 863....	6-23	7-16	23.0	23.01	45.00	1388.4
Hannchen, C. I. 531.....	6-28	7-21	24.0	18.17	47.50	1350.8

*32 lbs. oats—1 bushel
48 lbs. barley—1 bushel

The season of 1923 was most unfavorable for oats. However, the early varieties, such as Kherson and Iowar, gave the largest test weights per bushel, and Kherson the largest yield of grain per acre. These two varieties have indicated their adaptability and high-yielding qualities in cooperative tests on various farms. A comparison of oats and barley in the rotation is also possible. The best variety of oats (Kherson) gave a yield of 945.92 pounds, while the best variety of barley produced 1,218.24 pounds. The average yield of oats in New Jersey for the years 1919, 1920 and 1921, as reported by the Bureau of Crop Estimates, is 914 pounds per acre, while barley yielded for the same period 1,024 pounds per acre. The average United States yields for two 10-year periods are 1,026 pounds per acre for oats and 1,202 for barley. The farm price per bushel likewise slightly favors barley, the average farm value for the years 1910-1919, inclusive, being $1.54 per hundred weight for the oats and $1.60 per hundred weight for barley. Because of the poor adaptability of the oats crop to the climatic conditions of this state, it is believed to be desirable to reduce the acreage of this crop. Several possible substitutions present themselves, one of which is barley. This crop fits in the rotation without the requirement of any unusual changes, and is, without doubt, superior to oats, although this difference is not great. In several sections of the state soybeans are being successfully substituted, and in other sections the spring grain is entirely eliminated from the rotation

TIMOTHY VARIETY TEST

Harvest weights on the timothy variety test, seedings of which were made April 6 and 10, 1922, were made by taking 6 frames (area 12 square feet each) from systemmatically distributed portions of each of the $^1/_{40}$-acre plots. These plots having been seeded in duplicate and arranged to cover the soil variations, give a fair representation of the relative yields of the varieties included. Table 15 gives the yield of each of these plots.

TABLE 15

Timothy Variety Test, 1923

Plot	VARIETY	Yield green Weight per Frame Average 6 frames each	Green Weight per Acre	Actual Yield per Acre Cured Hay
		ounces	*pounds*	*tons*
17 S. W.	Cornell 4003	24.33 ± 1.284	5519.8 ± 291.3	1.29
16 N. E.	F. C. I. 9327	21.00 ± 1.100	4764.3 ± 249.5	1.04
16 S. W.	Cornell 4051	19.83 ± .5884	4498.9 ± 133.4	0.91
15 N. E.	F. C. I. 3937	17.16 ± .365	3893.1 ± 82.8	0.85
15 S. W.	Cornell 4001	20.66 ± 1.1618	4687.2 ± 263.5	1.15
14 N. E.	Check	14.83 ± .68	3364.5 ± 154.9	0.64
14 S. W.	F. C. I. 9400	19.16 ± 1.26	4346.9 ± 286.0	1.09
13 N. E.	Cornell 4036	10.86 ± 1.26	2463.8 ± 285.8	0.83
13 S. W.	Cornell 4031	13.5 ± .81	3062.8 ± 184.2	0.70
12 N. E.	F. C. I. 9327	13.16 ± .96	2985.6 ± 218.2	0.68
12 S. W.	Cornell 4003	19.66 ± 1.17	4460.3 ± 266.8	0.96
11 N. E.	Check	15.16 ± .726	3439.4 ± 164.7	0.81
11 S. W.	F. C. I. 3937	15.16 ± .32	3439.4 ± 72 8	0.70
10 N. E.	Cornell 4051	16.5 ± .71	3743.4 ± 161.6	0.87
10 S. W.	F. C. I. 9400	20.66 ± .75	4687.2 ± 170.6	1.15
9 N. E.	Cornell 4001	18.0 ± .81	4083.7 ± 185.1	0.93
9 S. W.	Cornell 4031	17.5 ± .37	3970.3 ± 85.9	0.93
8 N. E.	Cornell 4036	18.83 ± .53	4272.0 ± 121.2	0 55
8 S. W.	Check	14.33 ± .65	3251.1 ± 149.5	0.74

It is interesting to note that the yields of all of the selected varieties, with the exception of Cornell 4036, were better than the selected

commercial strain which was used for checks. Two of the varieties, Cornell 4003 and F. C. I. 9100, yielded better than 50 per cent above the check plots. Because of the abnormal season, it is very possible that other varieties may compare relatively better under normal conditions. New seedings of the same varieties were made September 19, 1923, and good stands have resulted in every case, so that further comparisons may be made during the present calendar year.

TABLE 16

Timothy Summary, 1923

VARIETY OR STRAIN	Average Height	Date of Cutting (Full Bloom)	Green Weight per Acre	Shrinkage	Cured Hay Yield per Acre	Relative Yield
	inches		*pounds*	*per cent*	*tons*	*per cent*
Commercial	28.3	7-10	3350.9 ± 85.3	56.4	.73	100.0
Cornell 4003	31.5	7-16	4991.2 ± 204.5	55.5	1.125	154.1
Cornell 4051	29.5	7-9	4126.0 ± 126.0	56.6	.89	121.9
Cornell 4001	32.0	7-10	4385.4 ± 170.9	52.5	1.04	142.5
Cornell 4036	24.0	7-10	3364.5 ± 236.6	58.3	.68	93.2
Cornell 4031	27.5	7-17	3516.5 ± 133.8	56.1	.815	111.7
F. C. I. 9327	29.5	7-7	3875.0 ± 239.7	50.4	.86	117.8
F. C. I. 9400	32.0	7-17	4517.0 ± 168.9	51.1	1.12	153.4
F. C. I. 3937	30.5	7-16	3666.3 ± 69.9	57.8	.775	106.2

1/40-acre plots were seeded April 10, 1922, with a nurse crop of barley, strains or varieties seeded in duplicate, except commercial, of which there were 3 plots. Six sections of 12 square feet were made on each plot for yield determinations. Hay was dried in field house to air dryness.

ANNUAL FORAGE CROPS

Yields of several of the annual forage crops which are worthy of attention in this state are given in table 17.

Sudan grass, which has in previous years given one of the best yields, for the present year, did not yield as well as the millets. In a normal season, however, it is expected that sudan grass will fully equal, if not exceed, these crops in yield of hay.

The corn-breeding project, inbreeding within self-fertilized lines, has now been continued with selfings for 3 years. A number of the strains are indicating their homocygosity by the remarkable uniformity of the general characteristics of the plants. The standard deviation of plant height and ear height, together with the coefficient of variability, the date of ripening, are given in tables 18 and 19.

TABLE 17

Annual Forage Crops, 1923

Plot	Rate of Seeding	Date of Seeding	Date of Harvest	Shrinkage in Green Weight	Green Weight	Dry Weight	Yield of Hay
	lbs.			*per cent*	*lbs.*	*lbs.*	*tons*
5A N. E. Amber Sorghum	25	9-30	10-15	62.5	5373	2015	1.00
S. W. Hungarian Millet	30	8-25	9-20	42.5	6553	3768	1.88
5B N. E. Sudan Grass	30	9-6	10-15	56.8	9120	3940	1.97
S. W. Japanese Millet	20	9-6	Very poor—not harvested	....	....	....	....
5C N. E. Hungarian Millet	30	8-25	9-20	50.0	10527	5264	2.63
S. W. Sudan Grass	15	9-6	10-15	59.6	9529	3850	1.93
5D N. E. Japanese Millet	20	9-6	Very poor—not harvested	....	....	....	....
S. W. Amber Sorghum	25	....	10-15	65.2	5831	2029	1.01
5E N. E. Sudan Grass	30	9-6	10-15	60.7	11616	4565	2.11
S. W. Sudan Grass	15	9-6	10-15	56.3	9824	3311	1.66
Summary							
Amber Sorghum	25	....	....	63.9	5602	2022	1.01
Hungarian Millet	30	9-20	....	46.3	8540	4586	2.29
Sudan	15	9-6	....	58.0	9677	4064	2.03
Japanese Millet	Failure	....	....	....	....	....	....
Sudan	30	9-16	....	58.8	10368	4272	2.14

Ten 12-sq. ft. sections were harvested per plot for yield test.

TABLE 18

Characteristics of Plants in Corn—Third Generation After Inbreeding Selected High Yielding Local "Varieties"

Series A Row No.	VARIETY	Hills Planted	Date Tasseling	Number Ears Inbred	Stand	Total Number of Suckers	Suckers per Plant	Number Smutted Plants	Smutted Plants
					per cent				*per cent*
1	Buffer Y. D. 34X	41	7-24	..	65.9	51	.63	15	19
2	Y. D. No. 1	41	7-26	12	64.2	7	.09	0	0
3	Y. D. No. 2	41	7-30	11	56.9	10	.14	32	46
4	Y. D. No. 3	41	7-30	12	64.2	6	.08	7	9
5	Y. D. No. 4	41	8-2	10	103.2	28	.22	5	4
6	Y. D. No. 5	41	7-24	12	82.9	8	.08	2	2
7	Y. D. No. 6	41	7-24	11	89.4	7	.06	13	12
8	Y. D. No. 7	41	7-21	10	85.4	9	.09	10	10
9	Y. D. No. 9	41	7-25	11	88.6	8	.07	4	4
10	Y. D. No. 10	41	7-30	12	82.1	14	.14	20	20
11	Y. D. No. 11	41	7-23	10	104.1	12	.09	8	6
12	Y. D. No. 12	41	7-30	11	87.8	11	.10	8	7
13	Y. D. No. 13	41	7-25	12	77.2	11	.12	3	3
14	Y. D. No. 15	41	7-30	12	87.0	7	.07	27	25
15	Y. D. No. 16	41	7-25	11	74.0	14	.15	4	4
16	Y. D. No. 17	41	7-27	11	30.9	7	.18	4	11
17	Y. D. No. 18	41	7-23	12	55.3	10	.15	7	10
18	Y. D. No. 19	41	7-23	12	80.5	11	.11	12	12
19	Y. D. No. 20	41	7-23	8	77.2	10	.11	25	26
20	Y. D. No. 21	41	7-23	12	81.3	14	.14	20	20

TABLE 18—Continued

Characteristics of Plants in Corn—Third Generation After Inbreeding Selected High Yielding Local "Varieties"

Series A Row No.	VARIETY	Hills Planted	Date Tasseling	Number Ears Inbred	Stand	Total Number of Suckers	Suckers per Plant	Number Smutted Plants	Smutted Plants
					per cent				per cent
21	Y. D. No. 22	41	7-19	12	78.9	17	.18	4	4
22	Y. D. No. 23	41	7-21	10	91.9	4	.04	11	10
23	Y. D. No. 24	41	7-26	12	74.0	15	.16	0	0
24	Y. D. No. 25	41	7-30	12	78.0	13	.14	10	10
25	Y. D. No. 26	41	8-2	9	58.5	17	.24	2	3
26	Y. D. No. 27	41	7-24	12	92.7	5	.04	6	5
27	Y. D. No. 28	41	7-23	10	77.2	14	.15	4	4
28	Y. D. No. 29	41	7-28	12	80.5	32	.32	8	8
29	Y. D. No. 30	41	7-30	15	100.0	18	.15	15	12
30	Y. D. No. 31	41	7-25	11	86.2	21	.20	1	1
31	Y. D. No. 32	41	7-25	10	96.7	8	.07	2	2
32	Y. D. No. 33	41	8-1	15	75.6	7	.08	2	2
33	Y. D. No. 34	41	7-28	12	89.4	20	.18	8	7
34	Y. D. No. 35	41	7-30	13	75.6	9	.10	0	0
35	Y. D. No. 36	41	8-1	14	79.7	7	.07	0	0
36	Y. D. No. 37	41	7-24	12	78.9	2	.02	0	0
37	W. C. No. 1	41	7-21	11	97.5	2	.02	0	0
38	Y. D. No. 38	41	7-22	12	94.3	7	.06	2	2
39	W. C. No. 2	41	7-25	12	91.9	4	.04	2	2
40	Y. D. 34X	41	7-29	..	91.9	17	.15	7	6
41	Y. D. 34X	41	7-29	..	74.8	13	.14	6	6

TABLE 18—Continued

Characteristics of Plants in Corn—Third Generation After Inbreeding Selected High Yielding Local "Varieties"

Series A Row No.	Total Number Main Stalks Lodged*	Main Stalks Lodged	Plant Height Mean	Plant Height S. D. P. E.	Plant Height C. V.	Ear Height Mean (Main ear)	Ear Height S. D. P. E. (top one)	Ear Height C. V.	Date of Ripening
		per cent	*inches*			*inches*			
1	0	0	85.26	8.26 ± .557	9.69	31.26	5.16 ± .348	16.51	9-7
2	0	0	95.34	6.95 ± .469	7.29	34.24	5.13 ± .346	14.98	9-15
3	6	8	106.98	8.68 ± .586	8.11	41.30	7.36 ± .496	17.82	9-16
4	0	0	113.04	10.39 ± .700	9.19	42.08	9.04 ± .609	21.48	9-16
5	1	1	98.22	9.02 ± .608	9.18	44.60	7.18 ± .484	16.10	9-16
6	0	0	110.18	8.81 ± .594	8.00	45.50	7.80 ± .526	17.14	9-15
7	0	0	114.12	9.00 ± .607	7.89	49.64	6.36 ± .429	12.81	9-14
8	1	1	105.32	8.65 ± .584	8.21	41.74	5.14 ± .347	12.31	9-9
9	0	0	103.22	7.39 ± .498	7.16	41.70	5.34 ± .360	12.81	9-13
10	0	0	96.24	5.52 ± .373	5.74	37.34	4.59 ± .310	12.29	9-9
11	0	0	114.42	7.00 ± .472	6.12	47.00	6.82 ± .460	14.51	9-5
12	0	0	87.34	7.38 ± .498	8.45	41.88	5.52 ± .372	13.18	9-18
13	0	0	105.86	8.38 ± .565	7.92	45.16	6.63 ± .447	14.68	9-6
14	0	0	93.70	5.34 ± .360	5.70	35.12	4.38 ± .296	12.47	9-9
15	2	2	104.08	7.70 ± .519	7.40	40.96	6.74 ± .454	16.46	9-15
16	1	3	105.29	8.01 ± .675	7.61	39.06	6.24 ± .525	15.98	9-9
17	1	1	92.07	13.55 ± .964	14.72	34.84	8.52 ± .606	24.45	9-6
18	3	3	106.58	10.55 ± .711	9.90	44.80	5.96 ± .402	13.30	9-15
19	0	0	101.86	11.10 ± .749	10.90	34.98	5.84 ± .394	16.70	9-13
20	2	2	98.98	6.53 ± .454	6.60	39.84	4.27 ± .288	10.72	9-9

TABLE 18—Continued

Characteristics of Plants in Corn—Third Generation After Inbreeding Selected High Yielding Local "Varieties"

Series A Row No.	Total Number Main Stalks Lodged	Main Stalks Lodged	Plant Height: Mean	Plant Height: S. D. P. E.	Plant Height: C. V.	Ear Height: Mean (Main ear)	Ear Height: S. D. P. E. (top one)	Ear Height: C. V.	Date of Ripening
		per cent	*inches*			*inches*			
21	2	2	85.12	9.14 ± .616	10.74	34.06	6.67 ± .450	19.58	9-3
22	0	0	90.36	7.31 ± .493	8.09	34.12	5.95 ± .401	17.44	9-6
23	2	2	103.76	7.44 ± .501	7.17	38.86	5.45 ± .367	14.02	9-14
24	0	0	92.64	5.15 ± .347	5.56	30.04	3.60 ± .243	11.98	9-20
25	31	43	97.58	7.63 ± .514	7.82	42.18	6.84 ± .461	16.22	9-20
26	2	2	109.22	8.12 ± .547	7.43	43.58	7.98 ± .538	18.31	9-7
27	15	16	99.76	8.14 ± .549	8.16	41.28	6.48 ± .437	15.70	9-7
28	0	0	96.44	8.42 ± .568	8.73	43.60	5.50 ± .371	12.61	9-16
29	0	0	84.00	7.80 ± .526	9.29	28.90	4.95 ± .334	17.13	9-9
30	0	0	97.10	5.98 ± .404	6.16	41.92	6.54 ± .441	15.60	9-10
31	0	0	101.48	8.74 ± .590	8.61	47.44	6.20 ± .418	13.07	9-15
32	44	47	80.06	6.21 ± .418	7.76	36.98	4.07 ± .274	11.01	9-18
33	0	0	91.24	10.70 ± .721	11.73	33.24	7.00 ± .472	21.06	9-9
34	86	92	78.54	6.49 ± .437	8.26	31.50	3.53 ± .238	11.21	9-10
35	5	5	103.28	9.30 ± .626	9.00	38.48	5.64 ± .381	14.66	9-14
36	1	1	107.46	10.35 ± .697	9.63	42.60	7.16 ± .482	16.81	9-7
37	29	25	80.76	5.31 ± .358	6.58	25.30	4.25 ± .286	16.80	9-2
38	0	0	72.92	4.36 ± .294	5.98	25.12	4.95 ± .334	19.71	8-27
39	0	0	102.78	7.69 ± .518	7.48	40.22	5.35 ± .360	13.30	9-7
40	0	0	89.58	8.21 ± .553	9.16	34.26	5.60 ± .378	16.35	9-9
41	0	0	86.42	10.53 ± .710	12.18	33.40	6.75 ± .455	20.21	9-9

P. E.—probable error
C. V.—coefficient of variability
S. D.—standard deviation

TABLE 19—Continued

Characteristics of Plants in Corn—Third Generation After Inbreeding Selected High Yielding Local "Varieties"

Series B Row No.	Total Number Main Stalks Lodged	Main Stalks Lodged	Plant Height: Mean	Plant Height: S. D. P. E.	Plant Height: C. V.	Ear Height: Mean (Main ear)	Ear Height: S. D. P. E. (top one)	Ear Height: C. V.	Date of Ripening
		per cent	*inches*			*inches*			
1	2	2	79.4	9.32 ± .629	11.74	29.4	6.12 ± .413	20.82	9-7
2	6	7	91.5	10.95 ± .739	11.97	36.8	6.58 ± .444	17.88	9-11
3	2	3	68.4	5.92 ± .399	8.65	24.5	4.15 ± .280	16.94	8-27
4	0	0	80.7	5.92 ± .492	7.34	18.2	4.68 ± .389	25.71	9-1
5	1	3	82.5	5.59 ± .450	6.78	18.9	4.60 ± .371	24.34	9-5
6	1	2	89.9	10.43 ± .704	11.60	30.5	6.16 ± .415	20.20	9-4
7	2	2	104.6	11.29 ± .762	10.79	37.9	7.69 ± .519	20.29	9-1
8	1	2	69.8	8.54 ± .576	12.23	20.2	5.57 ± .376	27.57	9-1
9	2	2	91.5	7.00 ± .472	7.65	34.5	5.39 ± .364	15.62	9-22
10	1	1	108.5	7.42 ± .500	6.84	46.5	6.26 ± .422	13.46	9-20
11	4	4	108.2	8.44 ± .569	7.80	41.0	5.58 ± .376	13.61	9-1
12	0	0	110.7	10.67 ± .720	9.64	44.7	6.54 ± .441	14.63	9-6
13	5	5	119.3	6.82 ± .460	5.72	51.4	5.03 ± .339	9.79	9-8
14	2	4	....	....	....	....	....	....	9-25
15	4	8	134.0	8.72 ± .634	6.51	62.4	8.58 ± .624	13.75	9-25
16	2	4	....	....	....	....	....	....	9-25
17	1	2	132.5	8.66 ± .584	6.54	62.9	8.53 ± .575	13.56	9-25
18	11	18	....	....	....	....	....	....	9-25
19	0	0	....	....	....	....	....	....	9-2
20	1	1	108.7	9.33 ± .629	8.58	44.5	6.60 ± .445	14.83	9-2
21	0	0	....	....	....	....	....	....	9-2

TABLE 19—Continued

Characteristics of Plants in Corn—Third Generation After Inbreeding Selected High Yielding Local "Varieties"

Series B Row No.	Total Number Main Stalks Lodged	Main Stalks Lodged	Plant Height Mean	Plant Height S. D. P. E.	Plant Height C. V.	Ear Height Mean (Main ear)	Ear Height S. D. P. E. (top one)	Ear Height C. V.	Date of Ripening
		per cent	*inches*			*inches*			
22	0	0	110.2	6.78 ± .457	6.15	43.8	4.49 ± .303	10.25	9-2
23	3	3	……	……	……	……	……	……	9-2
24	1	1	……	……	……	……	……	……	8-27
25	1	1	103.8	7.88 ± .532	7.59	36.4	5.20 ± .351	14.29	8-27
26	2	3	……	……	……	……	……	……	8-27
27	1	1	102.4	8.35 ± .563	8.15	35.6	5.12 ± .345	14.38	8-27
28	0	0	……	……	……	……	……	……	8-27
29	6	6	103.0	11.39 ± .768	11.06	35.7	7.73 ± .521	21.65	9-6
30	3	3	98.7	8.20 ± .553	8.31	35.6	6.56 ± .442	18.43	9-4
31	2	3	93.5	7.91 ± .534	8.46	30.9	5.26 ± .355	17.02	9-4
32	2	3	96.4	9.03 ± .609	9.37	33.4	6.62 ± .447	19.82	9-4
33	0	0	86.3	8.44 ± .569	9.78	28.6	5.90 ± .398	20.63	9-16
34	1	2	65.4	8.06 ± .573	12.32	18.0	4.87 ± .346	27.06	8-15
35	2	2	……	……	……	……	……	……	9-15
36	2	2	103.5	6.90 ± .465	6.67	36.8	5.13 ± .346	13.94	9-15
37	8	9	……	……	……	……	……	……	9-15
38	5	4	112.8	7.37 ± .497	6.53	50.7	6.01 ± .405	11.85	9-17
39	4	4	……	……	……	……	……	……	9-17
40	5	6	90.4	8.38 ± .565	9.27	33.7	5.98 ± .403	17.74	9-7
41	1	1	……	……	……	……	……	……	9-7

P. E.—probable error
C. V.—coefficient of variability
S. D.—standard deviation

The strains which show relative uniformity in series A, Nos. 10, 14, 20, 24, 30, 32, 34 and 38, are all strains of yellow dent corn, while No. 37 in series A, and 3, 4 and 5 in series B are originally a white cap yellow dent. No. 13 is a sport selected in 1921 from one of the yellow dent plots, and No. 22 is the Burr Leaming developed by Dr. Jones of the Connecticut Station, seed of which was purchased commercially. No. 36 is likewise a Burr Leaming obtained from another source. All of these lines will be selfed during 1924, and, in addtion, some crosses between the more uniform strains have been made.

Tests of Burr Leaming in comparison with selected local strains were made on 3 farms in Morris County, 3 in Sussex and 2 in Hunterdon. It is found that the variety has too long a season to be grown successfully as grain in Sussex County. In the Hunterdon County test, however, in comparison with two very high-yielding local strains, Burr Leaming gave a considerably larger yield, as indicated in tables 20 and 21.

TABLE 20

Test of Burr Leaming Seed Corn

Farm A at Pittstown, N. J. Harvested September 29, 1923.
Rows 264 feet 7 inches long, 3½ feet apart.

BURR LEAMING

	Row 1	Row 2	Row 3
Total number of ears	200	165	181
Ears infected with fusarium	9	20	16
Ears otherwise defective	14	10	7
Weights	201.5	198	209.5

These 3 rows were chosen from the middle of the block of Burr Leaming and buffer rows do not need to be discarded.

WHITE CAP YELLOW DENT

	1	2	3	4	5	6	7
Number of good ears	186	180	176	175	144	162	162
Ears infected with fusarium	13	14	19	21	34	22	30
Ears otherwise defective	9	6	9	11	9	4	7
Total number of plants erect	...	196	...	...	...	...	209
Plants down	...	26	...	...	...	...	11
Suckers and weak plants	...	8	...	...	...	...	3
Total weights	185.5	172	178	165	163	169	187

Robinson's White Cap is very early maturing corn and practically all of the ears were thoroughly mature. Plants were dead in practically every case.

The ears are close to the ground and of medium size.

Burr Leaming corn on Robinson's Farm was about the same stage of maturity as on the Snyder Farm. Shrinkage samples will doubtless show much greater shrinkage in Burr Leaming than on the Robinson corn.

TABLE 21

Test of Burr Leaming Seed Corn

Farm B at Pittstown, N. J. *Harvested* September 29, 1923.
Rows 219 feet long, 3½ feet apart.

BURR LEAMING

Rows	9	10	11	12	13	14	15	16
Total number of ears	168	156	160	150	159	160	138	161
Ears infected with fusarium	11	5	7	18	7	11	4	6
Other defective ears	3	3	6	1	1	6	2	8
Number of plants erect	163	...	...	...	...	...	166	...
Number of plants down	7	...	...	...	...	...	15	...
Suckers and weak plants,	7	...	...	...	...	...	13	...
Total weights (pounds)	153	139.5	167.5	154.5	149	166	142.5	161

SNYDER'S WHITE CAP

Rows	17	18	19	20	21	22	23	24
Total number of ears	122	107	142	150	116	128	115	127
Fusarium	6	31	2	4	31	19	32	11
Other defective ears	19	6	...	...	6	4	...	...
Number of plants erect	...	139	...	...	...	...	140	...
Plants down	...	25	...	...	...	...	21	...
Suckers and weak plants,	...	8	...	...	...	...	12	...
Total weight (pounds)	146	147	136	145	140	149	138	148

Both lots of corn contained a considerable amount of soft, immature ears. It seemed apparent, however, that the Burr Leaming was a trifle more mature than Snyder's White Cap. Mr. Snyder, however, felt that judging from appearance of the plant during the season that the Burr Leaming would be *later in maturing.*

Shrinkage samples were obtained, taking great care to get average ears.

TABLE 22

Test of Burr Leaming Seed Corn

Farm B. September 29, 1923.

SUMMARY

Burr Leaming	153.166	± 3.2343 pounds	(average per row [6 rows])
Snyder's W. Cap	142.5	± 1.4440 pounds	(average per row [6 rows])

Yield per Acre

Burr Leaming	8704.377 ± 183.7872 pounds	= 117.626 bushels (74 lbs. per bu.)*
Snyder's W. Cap	8098.232 ± 82.0620 pounds	= 109.435 bushels (74 lbs. per bu.)*

Farm A, Pittstown, N. J. September 29, 1924.

SUMMARY

Burr Leaming	203	± 2.2953 pounds	(average per row [3 rows])
Robinson's W. Cap	172.33	± 2.4608 pounds	(average per row [3 rows])
Burr Leaming	9551.9011	± 107.9882	= 129.07 bushels (74 lbs. per bu.)*
Robinson's W. Cap	7641.	± 115.7521	= 109.577 bushels (74 lbs. per bu.)*

*Shrinkage determinations to be made later will doubtless change this figure.

In the latitude of New Brunswick, Burr Leaming has also indicated its high-yielding qualities. In sections south of New Brunswick, however, as southern Middlesex, northern Monmouth and parts of Mercer, where white cap yellow dent is successfully grown, it is found that these varieties produce better yields than the Burr Leaming.

A comparison of selections of rough and smooth types of yellow dent corn on two farms in Mercer County was undertaken in cooperation with Mr. A. C. McLean, county agent of that county. The selections were made on each farm from seed which had already been stored, choosing ears which were relatively smooth and ears which were very apparently of the rough type from each lot of seed. It was not expected that any great difference in yield would result from this test, inasmuch as a growing season in Mercer County is sufficiently long to give ample opportunity for full development of the rough types. On the Probasco farm the smooth selections produced 82.4 per cent smooth ears by weight and the rough type 52.4 per cent smooth ears. The smooth type produced a crop 70 per cent of which was apparently disease free, while the rough type ears produced a crop with 60.6 per cent apparently disease free. The yields were practically the same within the limits of probable error. In the Croshaw test of the rough and smooth type corn, the smooth type produced 69.4 per cent smooth ears and the rough type 52.55 per cent smooth ears, while in a second test the smooth type gave 69.56 per cent and the rough type 54.5 per cent. The apparent freedom from disease was 63 per cent in the rough type and 74.6 per cent in the smooth type. The yields were, approximately, the same within the limits of probable error.

SOYBEANS

The position of soybeans as a crop in the state is rather unusual. As pointed out in the discussion on the trend of crop acreage in the state, it will be seen that the hay and forage crops show an upward trend. Small grains, particularly those which are poorly adapted to climatic and other conditions of the state, are rapidly decreasing in acreage. Corn alone of the cereals is maintaining production. Soybeans may occupy about the same place in the rotation as oats. The oats crop, as has been pointed out previously, is at a very decided disadvantage in maintaining a place for itself among the general crops normally grown in the state. The returns per acre and the profits are much less than the other common crops. The pounds of grain per acre returned on the average is lower than that of the other cereals, and the amount of nutriment produced per acre is likewise very low. All of these facts point to the possibility of a substitution of soybeans for oats. Extensive research work by the department of soil fertility at this institution has pointed out the efficiency of soybeans in maintaining the fertility of the soil. Some of the growers of the state make a practice of using soybeans as a soil-improvement

crop. Others, perhaps the greater number, use the crop as a hay crop, in many cases as an emergency hay crop when other hay is insufficient. The total acreage of soybeans in New Jersey, however, is low. The Bureau of Crop Estimates of the State Department of Agriculture estimated 1,000 acres for 1922 and 1,100 acres for 1923. In one or two sections of the state, notably in the dairy section in Mercer County, soybeans have come to be a more or less definite part of the normal cropping system of certain farms. In many portions of

TABLE 23

Analysis of Costs to Produce One Acre of Soybeans

SOYBEANS GROWN FOR HAY

	Acre Costs				
	Man Labor	Horse Labor	Machine Labor	Tractor Labor	Total
I. Preparing Seedbed and Seeding:					
1. Plowing	$1.35	$1.35	$0.53	$0.74	$3.97
2. Rolling and Planking	.02	.03	.01	....	.06
3. Discing	.26	.21	.13	.58	1.18
4. Other harrows	.33	.33	.18	.10	.94
5. Hauling lime	.10	.09	.05	....	.24
6. Applying lime	.07	.08	.07	....	.22
7. Applying manure	.13	.15	.06	....	.34
8. Applying fertilizer	.01	.01	....	....	.02
9. Inoculating seed	.01	....	....	....	.01
10. Seeding	.33	.39	.15	....	.87
11. Miscellaneous	.03	.02	.01	....	.06
Total Labor	$2.64	$2.66	$1.19	$1.42	$7.91
II. Cultivation:					
Total Labor	$0.05	$0.05	....	....	$0.10
III. Harvesting:					
1. Mowing	$0.39	$0.31	$0.12	....	$0.82
2. Tedding	.04	.03	.02	....	.09
3. Raking	.20	.24	.09	....	.53
4. Cocking and Capping	1.05	....	....	....	1.05
5. Loading, hauling and storing	2.76	1.36	.51	....	4.63
6. Other labor	.05	....	....	....	.05
Total Labor	$4.49	$1.94	$0.74	....	$7.17
Sum total (all labor)					$15.18

the state, however, the crop has not been adopted by the farmers, and there has been a question as to whether or not there were any real difficulties which would prevent the more general adoption of the crop on these farms for which there is a need for hay, or on other farms where both the grain and forage are grown for feeding on the farms or for soil improvement purposes. There was also a question as to whether or not the objections which have been advanced by some few growers who have tried the crop bore any relation to the degree of experience or lack of experience of the growers with the crop, which has certain specialized features not found in the other crops com-

TABLE 24

Soybeans for Hay

COST SUMMARY

Expense	Cost per acre
1. Seed	$4.41
2. Fertilizer	1.11
3. Manure	.37
4. Lime	2.52
5. Inoculation (culture)	.09
6. Use of truck	.01
7. Land Rental	6.91
8. Storage	.68
9. Interest	.49
10. Sum total of all labor	15.18
Total cost per acre	$31.77
Average return per acre	54.94
Net profit per acre	$23.17

monly grown. With this end in view, it was decided to make a survey of the growers of soybeans in the state, not only to gather what information might be possible as to costs and estimated returns, but also to gather the opinions of the growers and to determine, as far as possible whether or not any real reasons existed which would tend to limit the development of the acreage. The figures which follow were obtained by Mr. A. L. Diederich as a part of a senior thesis prepared in this department after personal visits to the growers and using a blank which was prepared under the direction and with the advice of Mr. Allen G. Waller, Research Specialist in Agricultural Economics. These figures are for a total of but 42 farms covering 512 acres, and present complete costs on 379 acres. While this is a very small group upon which to base any definite conclusions, it, nevertheless, represents over one-half of the total estimated acreage of the state, and it is believed that the figures represent rather accurately labor and maerial requirements of the crop.

The costs of growing an acre of soybeans for hay are given in tables 23 and 24.

The cost of growing soybeans for seed is given in table 25.

TABLE 25

Analysis of Cost of Producing Soybeans

SOYBEANS GROWN FOR SEED

	Acre Costs				
	Man Labor	Horse Labor	Machine Labor	Tractor Labor	Total
I. Preparing Seedbed and Seeding:					
1. Plowing	$1.10	$1.53	$0.69	$0.96	$4.28
2. Rolling and Planking	.08	.09	.04	....	.21
3. Discing	.08	.02	.04	.26	.40
4. Other harrows	.66	.41	.24	1.32	2.63
5. Hauling lime	.72	.39	.21	....	1.32
6. Applying lime	.22	.27	.10	....	.59
7. Applying manure	....	....	....	....	....
8. Applying fertilizer	....	....	....	....	....
9. Inoculating seed	.03	....	....	....	.03
10. Seeding	.36	.43	.17	....	.96
11. Miscellaneous	.03	.02	.01	....	.06
Total Labor	$3.28	$3.16	$1.50	$2.54	$10.48
II. Cultivation:					
Total Labor	$0.54	$0.64	$0.25	....	$1.43
III. Harvesting:					
1. Mowing	$0.48	$0.57	$0.16	....	$1.21
2. Tedding	....	....	....	....	....
3. Raking	....	....	....	....	....
4. Cocking and capping	....	....	....	....	...
5. Loading, hauling and storing	1.90	.89	.35	....	3.14
6. Other labor	....	.36	....	....	.36
Total Labor	$2.38	$1.82	$0.51	....	$4.71
IV. Threshing Cost			$0.92	....	$0.92
Sum total (all labor)					$17.54

TABLE 26

Soybeans for Seed

COST SUMMARY

Expense	Cost per acre
1. Seed	$4.40
2. Fertilizer	4.12
3. Manure	....
4. Lime	7.09
5. Inoculation (culture)	.03
6. Use of truck	....
7. Land Rental	7.41
8. Storage	.58
9. Interest	.66
10. Sum total of all labor expense	17.54
Total cost per acre	$41.83
Average return per acre	79.81
Net profit per acre	$37.98

The cost of growing soybeans for soil improvement is given in table 27.

TABLE 27

Analysis of Cost of Producing Soybeans for Soil Improvement

	Acre Costs Man Labor	Horse Labor	Machine Labor	Tractor Labor	Total
I. Preparing Seedbed and Seeding:					
1. Plowing*	$0.39	$0.26	$0.31	$1.10	$2.06
2. Rolling and Planking	.01	.01	....	....	.02
3. Discing	.33	.11	.15	1.11	1.70
4. Other harrows	.19	.06	.09	.64	.98
5. Hauling lime	....	....	....	....	....
6. Applying lime	.15	.18	.07	....	.40
7. Applying manure	.25	.29	.12	....	.66
8. Applying fertilizer	....	....	....	....	....
9. Inoculating seed	....	....	....	....	....
10. Seeding	.43	.26	.11	....	.80
11. Miscellaneous	....	....	....	....	....
Total labor	$1.75	$1.17	$0.85	$2.85	$6.62
II. Cultivation:					
Total labor	$0.02	$0.02	$0.01	....	$0.05
Sum total (all labor)					$6.67

*25 per cent of the growers prepared the ground by harrowing, omitting plowing entirely.

TABLE 28

Soybeans Grown for Soil Improvement

COST SUMMARY

Expense	Cost per acre
1. Seed	$4.92
2. Fertilizer	3.54
3. Manure	4.92
4. Lime	5.25
5. Inoculation (culture)	.05
6. Use of truck	.36
7. Land rental	11.57
8. Storage	....
9. Interest	.51
10. Hauling lime	.35
11. Sum total of all labor expenses	6.67
Total cost per acre	$38.14
Farmer's estimated value of return	42.36
Net profit per acre	$4.22
Residue of fertilizer, manure, lime	6.86
	$11.08
Difference between land rental on these farms and average rental	4.50
	$15.58

The time of planting soybeans is given in table 29.

TABLE 29

Time of Planting

For all purposes excepting with corn for ensilage.*

	Average Date of Seeding
1. Northern area	June 8
2. Central area	June 3
3. Southern area	May 18

*The average date of planting with corn for ensilage was May 18—all farms in Northern and Central areas.

The spacing of soybeans for different purposes is given in table 30.

TABLE 30

Spacing

Purpose for which grown	Distance apart in rows				
	7-9 in.	14-16 in.	32 in.	36-40 in.	Broad-cast
1. Hay and forage	9 farms	10 farms	1 farm	.. farms	1 farm
2. Seed crop	.. farms	2 farms	1 farm	.. farms	.. farm
3. Soil improvement	4 farms	3 farms	.. farm	.. farms	2 farms
4. With corn for ensilage	.. farms	.. farms	.. farm	5 farms	.. farm

The rates of seeding boybeans are given in table 31.

TABLE 31

Rates of Seeding

Purpose for Which Grown	No. farms	Average number bushels per acre
1. For hay	20	1.42
2. Forage crop	4	1.56
3. Seed crop	3	1.42
4. Soil improvement	9	1.47
5. With corn for ensilage	4	.25

The varieties of soybeans are given in table 32.

TABLE 32

Varieties*

	No. of Farms
1. Wilson	31
2. Mammoth Yellow	11
3. Haberlandt	1
4. Ito San	1

*Several growers used more than one variety.

The effect of lime, fertilizers and manure on yield is given in tables 33 and 34.

TABLE 33

LIME

Number of farms	5
Acreage	26.25
Production	69.50 tons
Average yield per acre	2.70 tons
Average yield all farms	2.73 tons

FERTILIZER OR MANURE

Number of farms	7
Acreage	22.25
Production	71.00 tons
Average yield per acre	3.20 tons
Average yield all farms	2.73 tons

FERTILIZER, MANURE AND LIME

Number of farms	2
Acreage	10
Production	32.00 tons
Average yield per acre	3.20 tons
Average yield all farms	2.73 tons

TABLE 34

The Use of Manure and Fertilizer on Soybeans

MANURE

Purpose for which grown	Number Farms Total	Farms Using Manure	Average Amount Manure per Acre *tons*
1. Hay	15	1	0.19
2. With corn for ensilage	3	3	11.00
3. Soil improvement	8	1	0.89
4. All other purposes	6	0	0.00
Total (all farms)	32	5	1.73
Total (excepting group 2)	29	2	0.57

FERTILIZER

Purpose for Which Grown	Number farms total	Number farms using A. P.	Average Amount of fertilizer to the acre A. Phosphate *lbs.*	Number farms using complete fertilizer	Average amount of fertilizer to the acre complete fertilizer *lbs.*
1. Hay	15	6	91.48	1	6.70
2. Seed crop	3	1	425.53	1	8.51
3. With corn for ensilage	3	0	....	2	259.99
4. Soil improvement	8	1	65.02	1	158.12
5. All other purposes	3	0	....	0	....
Total (all farms)	32	8	105.89	5	116.72
Total (exc. group 3)	29	8	119.78	3	98.03

The degree of satisfaction expressed by the grower is given in table 35.

TABLE 35

Degree of Satisfaction Expressed by Grower

	Positive +	Undetermined	Negative —
Number farms	32	7	3
Average number of years soybeans grown	3.1	2.3	1.3

The following expressions summarize the growers' points of view on this subject:

A. Positive: "*Degree of Satisfaction with Crop*"
  1. Very well satisfied
  2. Extremeiy satisfied
  3. Very satisfactory
  4. Enthusiastic
  5. Good for cows
  6. O. K.
  7. Very profitable crop
  8. Very good for land
  9. Fair

B. Undetermined:
  1. Very good *luck*
  2. Too risky
  3. Not so good as alfalfa
  4. Moderate
  5. Disgusted

C. Negative:
  1. Crop failure
  2. Not much
  3. Difficult to cure

There appears to be a rather close correlation between the experience of the grower as expressed in number of years which he has grown soybeans and the degree of satisfaction expressed. It is apparent that the men who have grown the crop for one year only have, in many cases, not attained the desired success. Doubtless questions of inoculation, the method of seeding, the time of seeding and the variety to use has a rather definite bearing on the degree of success. It would seem from examination of the results of this survey that the crop is a profitable one for a great many growers, and it is apparent that no real difficulties present themselves which would prohibit any considerable increase in acreage. Perhaps the objection advanced, which has more weight than any other, is the fact that, when grown in the rotation preceding wheat, sufficient time is not permitted for preparation of the seedbed for wheat. However, in most cases where this objection has been advanced, it is traceable either to the use of a long season variety or to abnormally late planting of the crop. These are difficulties which can be readily overcome, and a more general knowledge of the cultural practices of the crop will readily permit successful production by a large number of growers.

The crop cannot be too strongly recommended for those individuals who have need of hay for home feeding, and for many growers who are successfully using the crop for soil improvement purposes. A few growers are attaining success in allowing the beans to mature and in feeding the entire crop after grinding.

MISCELLANEOUS

Winter Cover and Green Manure Crop. A number of small pieces of work have been undertaken of which mention can be made under this heading. One of these is some preliminary work which has been done to determine the amount, proportion and rate of growth of top and roots in certain crops used as cover crops. New Jersey, as one of the leading states in the use of cover crops, has been forced to make recommendations of various crops for this purpose, without very much real information as to the relative merits of such crops. Crops most commonly used are rye, frequently winter or hairy vetch, or a mixture of rye and vetch, and occasionally some of the clovers, such as crimson, biennial sweet clover and others. Recently attention has been given to various varieties of rye for this purpose. Abruzzi, in producing a large top growth during the fall, is one of the crops which has attracted the attention and interest of growers. Some preliminary observations, however, seem to indicate that fully as great a difference existed between the dry matter in roots as the dry matter produced in tops, and there was a question whether the root growth in the case Abruzzi rye equalled or surpassed the native ryes. Preliminary work to obtain information on this point was made on the Feltman farm at Thorofare, N. J., the foot growth being determined by the use of a steel sampling frame, removing one cubic foot of soil. The root growth was removed by screening with suitable sized screens, washed, dried and weighed. Results of this work are given in table 36.

It is not believed that a sufficient number of samples of each were obtained to give absolutely reliable results in this preliminary work. However, it does indicate that a very great difference amounting to several hundred per cent exists in the total dry weight, the dry weight in tops and the dry weight in roots of these various crops. Accordingly, it has been decided to continue this work, checking up the samples obtained in the field with a series of pot cultures in which more accurate measurements of root growth may be made. In the field work not all of the root growth has been screened from the soil, although it is beleived that 85 to 90 per cent of the total has been removed.

Research Program. Some attention has been given to developing a sound research program for the department. Such a program should give due consideration to the trend of agriculture as a whole in the eastern states, and weigh with some degree of accuracy the relative importance of the various projects undertaken.

TABLE 36

Amount, Proportion and Rate of Growth of Top and Root in Certain Cover Crops

Feltman Farm, Thorofare, N. J. December 27, 1923

VARIETY	Sample	Total Dry Weight	Top	Roots
		gm.	*gm.*	*gm.*
Abruzzi	1	60.102	17.860	42.525
Abruzzi	2	88.452	21.262	63.787
Abruzzi	3	78.3	8.4	69.9
Hairy vetch	1	13.2	6.5	6.7
Hairy vetch	2	12.5	5.8	6.7
Hairy vetch	3	12.	7.	5.
Native rye	1	79.7	15.0	64.7
Native rye	2	63.2	13.2	50.
Native rye	3	21.6	7.	14.6
Hairy vetch and Native rye,	1	57.6	13.0	44.6
Hairy vetch and Native rye,	2	51.5	12.	38.5
Hairy vetch and Native rye,	3	39.3	7.6	31.7
TOTALS				
Abruzzi (3)		226.854	47.522	176.212
Hairy vetch (3)		37.70	19.30	18.40
Native rye (3)		164.50	35.20	129.30
Hairy vetch and Native rye (3)		148.40	32.60	114.80

Variety	Growth per Acre
	pounds
Abruzzi	7,262
Hairy vetch	1,207
Native rye	5,266
Hairy vetch and Native rye	4,750

A study of the trend of crop acreage in the state during the past 50 years shows:

(1) A marked decrease in acreage of all cereal crops.
(2) A marked decrease in production of all cereals except corn and rye.
(3) A marked increase in acreage and production of potatoes.
(4) An increase in production of hay.

Corn has made a significant increase in acre yield during this period, reaching an average of well over 40 bushels per acre, thus showing its adaptation and value under local conditions. Rye, likewise, is well adapted to large portions of the southern half of the state, and, under certain conditions, has been of particular value as a cash crop when sold for straw. Potatoes have shown a very marked increase in intensity of culture and have come to be a crop of large commercial value. Increase in production of hay has naturally followed increase in local demands for market milk. Recent increases in freight rates have likewise stimulated production of hay in the state, since, with a transportation cost of more than $5.50 per ton from western New York to New York City, hay grown west of this point meets with difficulty the competition of New Jersey grown hay. Also, the increasing success of New Jersey growers with such crops as alfalfa, soybeans, etc., has been of much assistance in raising the acre yield. Under many conditions the hay crop has proved to be one of the most profitable in recent years, if not the most profitable, of all the crops grown on the farm.

Cereal crops, such as wheat, and, particularly, oats, are not well adapted to the climatic and soil conditions of many parts of the state. Buckwheat has a very narrow adaptation to the conditions found in New Jersey. These crops very probably are decreasing rapidly in importance.

The research program of the department should apparently be designed to give the most consideration to these crops, which are of large and increasing economic importance. The various hay crops—alfalfa, varieties of timothy, soybeans and others—are deserving of the utmost consideration in a research program. Likewise the corn crop, which is grown in small individual acreages by large numbers of growers, is in the aggregate a crop of large commercial value. If by breeding methods the varieties and strains of corn now grown may be improved to give a 10 per cent increase in yield, which is a very conservative estimate, the annual value of such an increase would be considerably above one million dollars. The various native strains or varieties of rye are, in many cases, proving superior to the best imported varieties, but great variation exists among these native strains, and selection of the better ones may very readily increase the value of this crop to a very considerable degree. It is the aim of the department in building a research program, therefore, to give due weight to these considerations, and devote as large a proportion of time as is possible to projects bearing on the efficiency of production of the above crops.

Report of the Department of Agricultural Economics

HENRY KELLER, JR.[1]

BULLETINS OR ARTICLES PUBLISHED OR IN PRINTER'S HANDS

Considerable material has been covered during the past year, and is either already published, or will be, by July 15. Cooperating with the State Department of Agriculture, at Trenton, the following subjects have been investigated:

1. *Sweet Potatoes.* Information covering complete costs and practices in the sweet potato industry of New Jersey were gathered from 300 farms. This material has been published in Circular 70, from the state department, under the title "Cost, Profits and Practices of the Sweet Potato Industry in New Jersey, 1922," by Allen G. Waller and Harry B. Weiss.

2. *Food Consumption and Production in New Jersey.* The rapidly growing population of New Jersey, with the corresponding decline in acreage, devoted to agriculture, and the rising land values in certain sections due to urban influence, have resulted in certain changes in our farming area. The facts of growing population and rising land values make necessary more intensive farming in some sections, and with the idea that market requirements are necessary in considering any agricultural program, figures were obtained upon what the food production and consumption in New Jersey is. This material is being published by the state department in Bulletin No. 40, under the authorship of Allen G. Waller and Harry B. Weiss. It shows, as might be expected, very large shortages in most food production so far as New Jersey production and consumption requirements are concerned. It also shows from what principal sources the deficit in food for our population is obtained.

3. The state department, cooperating with the experiment station, has gathered over 200 records from alfalfa growers in the state, covering both north and south Jersey. These records show complete costs in raising the crop, some factors on the farm organization, such as livestock kept, and cropping system. This data is now being tabulated and will be printed as a state department Bulletin, under the authorship of Allen G. Waller and Harry B. Weiss.

Extension Bulletins

Coöperating with the Extension Division of the State Agricultural College, two extension bulletins have been written and are in the printer's hands.

[1]*Note by Editor:* In Professor Keller's absence, this report was prepared by Allen G. Waller.

Extension Bulletin 36, "How Some Farmers Make Poultry Pay," is under the authorship of W. H. Allen and Allen G. Waller. The data in this bulletin was gathered from records which are kept by a large number of commercial poultrymen in cooperation with the extension specialist in poultry, W. H. Allen.

Extension Bulletin 37, "Vegetable Yields in New Jersey, Monmouth and Gloucester Counties," by Allen G. Waller, gives a discussion of the average yields and the ranges of yield from minimum to maximum for many of the small vegetable crops. A large part of central Jersey is being so affected by high fixed charges against the farms in the way of taxes and interest, that the farmers are considering the possibilities in different crops from those they are growing now. Therefore, this material on vegetable yields was tabulated in the hope that such information would be useful under these conditions.

COST ACCOUNTS

The cost of production project has been continued during the past year in cooperation with the United States Department of Agriculture, making the fourth year that this project has been carried on in charge of Allen G. Waller. On July 1 Mr. Waller resigns his connection with the station to take up duties with the United States Department of Agriculture at Washington, and is taking the data with him. He hopes to work up this material in form for a publication from the station some time during the next fiscal year.

FRUIT WORK

Cooperating with the United States Department of Agriculture, a fruit project was started in the summer of 1923, which included gathering records on the cost of producing peaches and the cost of marketing these same peaches, or, in other words, the margins which were obtained by each agent from the producer to the consumer. This was made possible by the cooperation of the New Jersey Fruit Growers' Cooperative Association, through whose cooperation we were largely helped in securing records from the growers who belonged to the association. The margins, after these peaches left the association packing-houses, were obtained on the Newark market with the cooperation of a commission house, which handled the association peaches. The field records were taken mostly by Mr. Carl R. Swinson, of the United States Department of Agriculture, and the data on the margins in the Newark market were obtained by Mr. F. L. Manning and Mr. J. S. Hathcock, graduate students in the department of agricultural economics. The complete data of this study is being printed in a report to the United States Department of Agriculture, which will be submitted on July 1.

POULTRY PROJECT

The collection of material has been going on during the year, and the results are now being worked into position for printing. It is purposed to use multiple correlation analysis on the material gathered so that the truest possible results may be obtained.

RURAL LIFE PROJECT

In cooperation with the section of Rural Life, Bureau of Agricultural Economics, United States Department of Agriculture, this department has been gathering statistics concerning rural life conditions in New Jersey. The facts, together with photographs illustrating them, will be published under the title "Rural Life in New Jersey Worth Imitating."

Report of the Department of Biology

THURLOW C. NELSON

I. INTRODUCTION

A. Condition of the Industry

With each succeeding year the oyster industry of New Jersey becomes of relatively greater importance to the people of the state and of the country as well. While the output of oysters from New York, the New England states, Maryland and Virginia has steadily decreased within the last 12 years, the oyster crop of New Jersey has been as steadily growing, until now this state ranks third in oyster production in this country (10). The position of the oyster industry in New Jersey at the present time is due to the following: First, the decline in production of other formerly leading states; second, the rigid enforcement of the Rough Cull Law by virtue of which the natural beds of Delaware Bay have been saved from depletion; third, the fortunate location of the natural beds of Delaware Bay, in that they have not as yet suffered serious damage from industrial wastes, and fourth, the development of new seed producing areas, notably Barnegat Bay and Mullica River.

B. The Station at Bivalve

It is a source of much satisfaction that, under the law of 1911 establishing branch observation stations for the study of oyster culture, the legislature increased to $6,000 the total appropriation for our work. With this increase a permanent field station has been established at Bivalve on the Maurice River. The laboratory is adequately housed in two rooms at the northern end of the wharf, from which are shipped most of the oysters harvested in Delaware Bay. The work is in charge of a permanent investigator who devotes his entire time to research. Being close to the shipping center, he is in a position to render advice and to give aid in all matters requiring his attention. The laboratory was in charge of Mr. George F. Pilz, B.S., during July, 1923, his place being taken early in August by Mr. W. H. Dumont, M.S., the present assistant biologist. In order not to transcend the limits of this report, the results of Mr. Dumont's work will be published separately.

C. The Floating Laboratory "Cynthia"

The Cynthia was put into commission in April, and was brought from Tuckerton to Berkeley on May 7 and anchored in Hopper's Basin, about two minutes' walk from the Berkeley railroad station. This location is opposite the mouth of Toms River and but a few hundred yards from the natural oyster bed by Seaside Park, and within thirty minutes' run by launch of the most distant planting grounds in Barnegat Bay. It has been possible in this anchorage to secure electric connection with the town of Seaside Park, thus enabling us to operate a high-speed centrifuge by which alone it is possible to obtain the very minute organisms of the nannoplankton, which make up so large a part of the oyster's food.

The summer of 1923 brought several surprises, among them the almost complete failure of the oyster set in Barnegat Bay. The work of the season is considered in the following sections.

II. WEATHER AND WATER CONDITIONS

In the report of this department for 1922 it was shown that the accumulated deficiency in rainfall for New Jersey from 1912-1921 was 34.35 inches. During 1922 a deficiency of 5.25 inches raised the total to 39.5 inches. The year 1923, following the precedent set by the two preceding years, fell short by 5.92 inches of the normal precipitation, thereby bringing the accumulated deficiency since 1912 to 45.42 inches, or only about 1 inch less than the amount of rain which falls during an entire year of normal rainfall. The year 1924, up to June 30, has been in marked contrast to the three preceding years. Precipitation to May 31 was above normal for all sections of New Jersey.

Our investigations in upper Barnegat Bay were begun in May, 1921, hence it must be emphasized that the period covered by our work there has coincided with 3 years of unbroken comparative drought. The accumulated deficiency in rainfall for the 3-year period, 1921-23, is 19.25 inches, within 3 inches of a half year of normal rainfall. In how far the conditions found by us during this period may be normal for this region can be determined only by future work. There is little doubt that the rapid growth which oysters have made in upper Barnegat Bay since 1921 is directly traceable to the higher salinities with better feeding conditions, which have obtained during this time.

In general, it may be said that the salinity of the waters of upper Barnegat Bay in 1922 and 1923 have approached those characteristic of the lower bay in years of normal rainfall. In table 1 is given the average specific gravity of the water at Barnegat Pier and the mouth of Cedar Creek for the 3-year period. Note the very rapid rise in specific gravity from May to June, 1921, and the high

average maintained until the spring of 1924, when, with a return to normal rainfall, the water approached the average for May, 1921.

The summer of 1923 did not present favorable conditions for spawning of oysters in Barnegat Bay, although elsewhere in the state conditions were about normal. Short periods of warm weather were interrupted by days of cold easterly and northerly winds, with the result that spawning was intermittent and extended over a relatively long period.

TABLE 1

Average Specific gravity of Water Taken Within 1 Foot of the Bottom at all Stations. Figures Represent Sea Water Referred to Distilled Water at 17.5°C.

	May	June	July	August
1921	1.0075	1.0150	1.0167	....
Number of samples	7	71	34	....
1922	....	1.0166	1.0160	....
Number of samples	....	48	25	....
1923	....	1.0122	1.0127	1.0132
Number of samples	....	72	118	34

The autumn and early winter were remarkable for uniformly high temperatures and clear days, thus making possible the continuance of field observations (made by the biologist during week-end trips to Berkeley), until January 19, 1924. Barnegat Bay remained unfrozen until January 5, when it became icebound for several days, then opened until about the twentieth, when it again froze. From this date until March 1 cold weather throughout the state resulted in but few oysters being harvested.

III. FURTHER OBSERVATIONS OF THE ABUNDANCE, DISTRIBUTION AND SETTING OF OYSTER LARVAE

A. Barnegat Bay

The oyster set of 1923 was a failure commercially, due apparently to two causes: (a) Unfavorable weather conditions in June, and (b) the inroads of myriads of ctenophores or "comb jellies," "sea walnuts," *Mnemiopsis leidyi*, upon the oyster larvæ in the water. A detailed account of the occurrence of this jellyfish in New Jersey and its food habits has already been published, and to this the reader is referred for details (8). It may be said here, however, that bivalve

larvæ were found to play an important part of the food of this ctenophore as high as 125 straight-hinge oyster larvæ being found in the stomodeum or digestive cavity of a single *Mnemiopsis*. These animals occurred literally in swarms throughout all parts of Barnegat Bay from June 21 until late in December. Numbers as high as 20 to 30 per cubic yard of water were often found over the oyster beds. During the seasons of 1921 and 1922, when large sets of oysters and shipworms occurred in this region, *Mnemiopsis* was either very rare or absent altogether.

The surveys of the oyster larvæ in upper Barnegat Bay in 1921 and 1922 demonstrated that these larval bivalves are distributed over most of the area lying between the mouth of Cedar Brook and the mouth of Toms River. The best sets were found to occur in about the center of the bay passing from about the middle of the railroad bridge in a southwesterly direction across the eastern half of the Sloop Creek natural bed to the mouth of Cedar Creek. It was decided, therefore, to determine the abundance of larvæ over this pathway, taking samples at frequent intervals.

The following stations were established:

1. NE. corner of Sloop Creek Natural Bed (as in '21, '22).
2. Center of west line Cedar Creek Natural Bed.
3. SE. corner Earl Cranmer, ground, east line between lots 1253-1255.
4. SE. corner Manwaring ground by railroad bridge.
5. Abandoned during survey.
6. W. line of lot 1255 Arnold Cranmer. Between lots 1255 and 1245.
7. E. corner between 1271 and 1270, Arnold Cranmer.
7A. S.W. corner of lot 1271.
7B. W. corner between 1263 and 1260.
8. Barnegat Pier. NW. corner Elsworth ground.
13. SW. corner Will Harvey ground in lower Bay.

Station 8 was placed at the edge of the channel by the drawbridge at Barnegat Pier; the remaining stations lay in nearly a straight line from No. 4 by the railroad bridge southwest to the mouth of Cedar Creek. Stations 3, 4, 6, 7, 7A and 7B lay in a "slough" of deeper water, approximately 1 yard in depth, which separates the flats into a western and eastern portion. (See report for 1922.) Stations 7A and 7B were placed within 100 yards of 7 in order to determine local variations in the numbers of oyster larvæ at closely adjacent points.

Figure 1 gives the average number of oyster larvæ taken at all stations, together with the average temperature and specific gravity of the water. The heavy toll of oyster larvæ levied by the ctenophore, *Mnemiopsis leidyi*, is illustrated by the reduction in the numbers of oyster larvæ from an average of 9,117 per 100 quarts on June 23 to an average of 2,503 by June 27, a drop from 1,353 to 497 from July 7 to 9, and a fall from 5,817 to 217 between July 13 and 17.

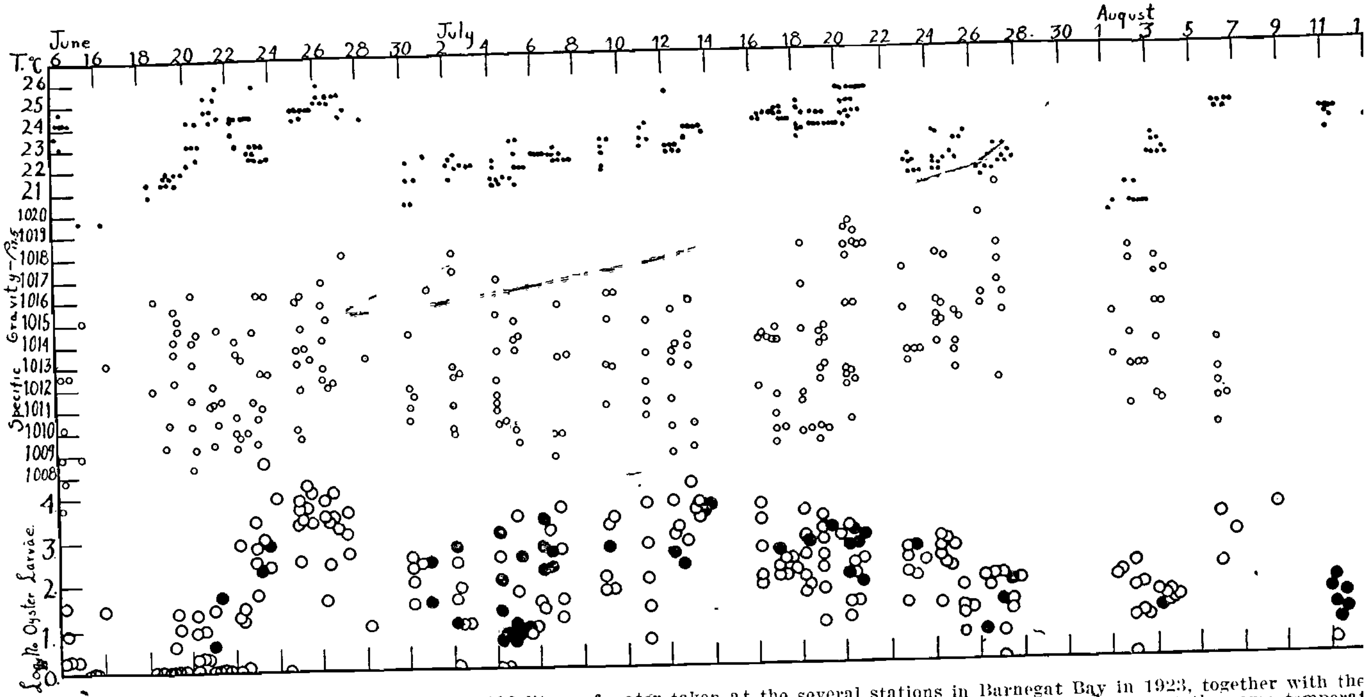


FIG. 1. The number of oyster larvæ per 100 liters of water taken at the several stations in Barnegat Bay in 1923, together with the temperature of the water in degrees centigrade and the specific gravity of the water at 17.5°C. referred to distilled water at the same temperat ture of the water in degrees centigrade and the specific gravity. and the large circles show the logarithms of the n black dots represent temperature readings, the small circles denote specific gravity, and the large circles show the logarithms of th oyster larvæ of all sizes per 100 liters of water. The numbers 1, 2, 3, 4, at the lower left are the characteristics of the logarithms of th 10, 100, 1,000 and 10,000, respectively. For example: The largest number of larvæ taken in any sample during the summer was appr 66,000, shown by the highest circle on June 23; the smallest number was 0, as indicated on several days by the circles on the 0 line. black circles show those samples which contained mature oyster larvæ which were approaching setting size.

B. Delaware Bay

The natural beds of Delaware Bay received the usual amount of set, much of which, however, was destroyed on the Egg Island Beds, New Beds and lower Bennies Bed through the activities of the drill *Urosalpinx.* The marked deficiency in rainfall over the three previous years, as discussed in our reports for 1922 and 1923, resulted in a wide extension of the areas in which this pest, together with its equally destructive mate, *Eupleura,* can operate. It is to be hoped that, with the return to normal rainfall in the spring of 1924, these snails will be driven out or killed over all of the natural beds in Delaware Bay.

Shelling of the Natural Beds. In our report to the Board of Shell Fisheries for 1922 it was shown that the Egg Island Beds were rapidly nearing a state of serious depletion. With this condition in mind the oyster growers of the region, through a direct tax on tonnage, raised sufficient revenue to plant about 100,000 bushels of shells upon the lower Natural Beds between Bennies Bed and the Southwest Line.

C. The Mullica River

After many years of dissention and ill-feeling on the part of the oyster growers of the region, the state has finally succeeded in working out a practical method of leasing most of the available ground in the Mullica River. There remains only the very productive area at the month of Bass River, which, owing to its depth, 25-30 feet, and limited room in which to operate a dredge boat, must eventually be taken over by a cooperative group of oyster growers. As indicating the importance of these areas in the Mullica River, the rental, which elsewhere in the state varies from $0.75 to $2.00 per acre, is here $10 per acre. Between the mouth of the Mullica River and the Iron Bridge lies some of the best oyster seed-producing ground in the country. Swift currents, a hard bottom which in many places is covered with gravel which, of itself, catches many spat, and an absence of enemies of the spat, makes this region an ideal one for seed production.

These newly-leased areas were examined with the cooperation of the director of the board of shell fisheries, Mr. George A. Mott, on August 29, 1923. With early ebb tide the water over the Graveling Bed at the mouth of the river showed at a depth of 20 feet a density of 1.0154, temperature 70° F., pH 7.9. At the Iron Bridge, with the tide 2 hours ebb, the water at a depth of 18 feet showed a density of 1.0131, temperature 75° F., pH 7.5. The lower density and alkalinity, and the higher temperature, were the result of water from the Cedar Swamps, which supply so large a part of the water to this river.

Examination of the shells showed that a heavy set over all the shelled areas from Deep Water Point to the Iron Bridge had occurred about August 20. The vigorous and heavy growth of the sets of previous years, many of the spat attaching to the natural gravel, is illustrated in plate 1, figures 1 and 2.

IV. THE NANNOPLANKTON AS A SOURCE OF THE OYSTER'S FOOD

Martin (4) showed that the bulk of the oyster's food may be composed of minute flagellates, peridines and other forms so small that they pass readily through the meshes of a plankton net, and, hence, had been largely neglected by earlier investigators. This fraction of the plankton, which can only be obtained from the water by use of a high-speed centrifuge or by a very fine filter, is known as the nannoplankton.

In our study of this most important part of the organisms, which swarm in both fresh and salt waters, we employ a high-speed centrifuge, R.P.M. 20,000, the invention of Mr. J. P. Foerst, technician of the physics department of the university of Wisconsin, in collaboration with Mr. C. Juday, of the zoology department of the same institution (fig. 3). Five of these centrifuges are now in use in different parts of the world, and one of them has been used quite extensively by Birge and Juday in their study of the nannoplankton of Wisconsin lakes (1). The instrument has the advantage of being easily portable, and will operate wherever ordinary lighting current is available.

The investigations of Birge and Juday on Wisconsin lakes, the waters of which contain much calcium carbonate in solution, show a mean content of the organic matter of the nannoplankton of from 4.8-7.8 times as great as in the net plankton. Individual samples at certain times of the year, coincident with the great increase in numbers of usually only one or two species of organisms, showed an organic content of the nannoplankton as high as 25 times as great as that of the net plankton.

Our investigations of the nannoplankton of Barnegat Bay have been in progress only a few months, hence it will suffice to report at this time that the results of preliminary tests indicate that in bulk the nannoplankton of a brackish water estuary such as Barnegat Bay may equal or exceed that of a hard-water lake. This is especially true of the minute green flagellates which form so large a part of the oyster's food. In partially land-locked areas or basins, the nannoplankton may greatly exceed that found in the open bay, due to the decomposition of marine plants and the relatively small circulation. During the night the excess of decomposition and respiration over photosynthesis may result in the entire body of water becoming distinctly acid, followed by a return to alkaline conditions during the day. The great productivity of the nannoplankton in such basins reveals the possibility of employing them for the purposes of fattening oysters, as is done on so large a scale in parts of Europe. Careful study would have to be made, however, to avoid drawing too heavily upon the oxygen supply of such a pond, thereby resulting in the death of the oysters.

V. MARINE BORERS

A. The Effects of the Type of Wood Upon the Shell Characters

Specimens of *Teredo navalis* taken from oak piling drawn from the railroad bridge at Barnegat Pier in July, 1922 (7) bore shells which differed markedly from those of teredos obtained from soft white cedar nearby. The shells of the borers from oak were a deep brown in color and bore dental ridges with denticles far more prominent than was the case with the shells taken from white cedar.

The shell of a shipworm is a secreted structure, and as such may be expected to show the effects of environmental influences. Miller (5) has been able to correlate variations in the characters of the shells of *Teredo* with differences in salinity and temperature. Wide differences were found to exist, for example, between the shells of borers taken near the surface of the water and those removed from just above the mudline in the same pile.

Of all the factors which may influence the form and nature of the shell of a marine borer, none is so intimate in its relationship to the shell as is the wood in which the mollusc is boring. Gonggrijp (3) makes a beginning in the study of this problem and figures interesting photomicrographs of the structures of various woods from which teredos have been removed. He does not make a detailed study of the minute shell characters of the teredos found in these woods.

In order to determine what effects the nature of the wood bored may have on the shell characters, the following experiment was made. Through the cooperation of the Forest Products Laboratory of Madison, Wisconsin, billets of wood 12 by 4 by 2 inches were obtained in the following woods representing varying degrees of hardness: Balsam, western hemlock, Sitka spruce, Douglas fir, long-leaf pine, black willow, greenheart, maple, hickory, white oak. The billets were fastened side by side to an underpinning of white cedar 2 by 4 inches to form a raft. Two such rafts were made and sunk by means of window weights, one at station 1 on the Sloop Creek Bed, the other at the mouth of Tide Pond Creek, two points at which heavy shipworm attacks occurred in 1921 and 1922. The rafts were put out July 1 and removed September 7, at which time they were heavily coated with slime, algæ, tunicates and barnacles, while on tbe under side were numerous oysters.

The shipworm set of 1923, as noted in section III of this report, was very light in Barnegat Bay, hence it was not suprising to find, after careful examination, the pallets of only 21 Bankia in the raft at Tide Pond Creek, and but 8 Bankia in the raft at station 1. The rafts were kept for the following season in the hope that conditions more favorable to infection might then be found to prevail.

B. Parasites of Teredo and of Bankia

Three timbers were removed from Conklin's Island, Barnegat, July 26, 1923, ebb tide, specific gravity, 1.0200, temperature 74.5° F. These yielded 1 large specimen of Bankia, 1 small specimen of the same genus and 13 small Teredo of that season's set. The gills of all the molluscs were found to be swarming with heterotrichous ciliates which swam actively about posterior end foremost. These parasites were described by Durand (2) from teredos taken from a float in the Norfolk Navy Yard, but their taxonomic position was not determined by this investigator. There is no doubt but they belong in the genus *Boveria* established by Miss Stevens (9) to receive a ciliate parasite parasitic on the respiratory tree of a holothurian. The parasite has been placed by me in a new species *teredinidi* owing to certain marked differences between it and *B. subcylindrica,* Stevens. A full description of this parasite will be presented in a technical journal.

Since these parasites were not observed in 1921 or 1922, it was at first thought that they might have been responsible for the light shipworm infection of 1923. Further investigation showed, however, that they probably do little, if any, harm to the host, merely using the gills as a place of attachment and living on nannoplankton carried to them in the stream of water from the incurrent siphon of the host. The heaviest infections found were in large specimens of Bankia 2 to 4 years old, which, apparently, were fat and in good condition when examined.

SUMMARY

The oyster industry in New Jersey steadily increases in importance whereas at nearly all other oyster-producing centers there has been a marked decline.

A permanent field station for study especially of problems incident to shipping was established at Bivalve on the Maurice River, July 1, 1923.

The dry weather of 1923 has brought the accumulated deficiency in the rainfall since 1912 to within about one inch of an entire year's normal rainfall. This deficiency has resulted in a wide increase in the area over which the oyster drills operate and in some sections, notably Little Egg Harbor, oysters were very poor during most of the season.

The oyster larvæ and other bivalve larvæ produced in 1923 were mostly eaten by the "jelly fish" *Mnemiopsis leidyi*. As high as 125 early oyster larvæ were taken from a single specimen of this ctenophore.

Good sets of oysters occurred in the Mullica River and in Delaware Bay where the ctenophores were relatively rare.

A beginning has been made in the study of the nannoplankton of oyster-producing areas. Preliminary tests indicate that this fraction of the total plankton may exceed that of a hard-water inland lake.

Two rafts of 10 different kinds of wood of varying degrees of hardness were sunk in the bay in the hope of securing a set of shipworms. It was designed to test the effects of the wood upon the shell characters. Owing to the inroads of *Mnemiopsis* upon the larvæ only 29 Bankia were found in the two rafts which were therefore saved for the following season.

A heterotrichous ciliate, *Boveria teredinidi*, Nelson, has been found parasitic in great numbers upon the gills of Teredo and of Bankia.

REFERENCES

(1) Birge, E. A., and Juday C. 1922. The Inland Lakes of Wisconsin. The Plankton. Wis. Nat. Hist. Survey, Madison. Bul. 64.

(2) Durand, W. F. 1887. Internal Parasites of *Teredo navilis*. *In* Amer. Mo. Micros. Jour., v. 8. p. 224-226.

(3) Gonggrijp. J. W. 1923. Over paalworm En tegen paalworm bestand hout. Overgedrukt uit "De Indische Mercuur." v. 1. no. 8, June, 1923.

(4) Martin. G. W. 1923. Food of the Oyster. *In* Bot. Gaz., v. 75, no. 2, p. 143-69.

(5) Miller, R. C. 1922. Variations in the Shell of *Teredo navalis* in San Francisco Bay. *In* Univ. Cal., Dept. Zool., v. 22, no. 2, p. 293-328.

(6) Nelson, T. C. 1923. On *Boveria teredinidi*, Sp. Nov., from the Gills of Teredo and of Bankia. *In* Anat. Rec., v., 26, no. 5, p. 356.

(7) Nelson. T. C. 1924. *Report of the Department of Biology for 1923*. N. J. Agr. Exp. Sta., p. 193-210.

(8) Nelson, T. C. 1925. On the Occurrence and Food Habits of Ctenophores in New Jersey Inland Coastal Waters. *In* Biol. Bul., v. 48, no. 2, p. 92.

(9) Stevens, N. M. 1904. Studies on Ciliate Infusoria. *Licnophora macfarlandi*, sp. nov. *Boveria subcylindrica*, gen et sp. nov. Proc. Cal. Acad. Sci., v. 3, s. 3.

(10) Tressler, D. K. 1923. Marine Products of Commerce. Chapter 27. The World's Oyster Industry, by J. S. Gutsell. Chem. Cat. Co., New York.

PLATE 1

FIG. 1.

FIG. 2.

FIG. 3.

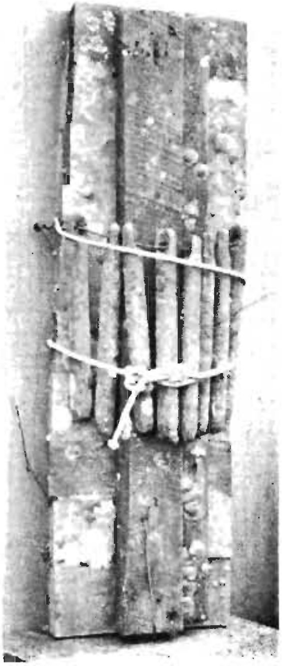


FIG. 4.

FIG. 1. Natural seed from Iron Bridge, Mullica River, August, 1923.
FIG. 2. Natural seed set on gravel at mouth of Bass River, Mullica River.
FIG. 3. The Foerst Centrifuge for determination of Nannoplankton.
FIG. 4. Raft of 10 kinds of wood of varying degrees of hardness used to secure shipworm infection.

PLATE 2

PLATE 2. New 12 H. P. Sea skiff used in survey work by this department.

Report of the Department of Soil Chemistry and Bacteriology

Jacob G. Lipman

Augustine W. Blair

THE CONTINUOUS GROWING OF WHEAT AND RYE WITH AND WITHOUT A LEGUME GREEN-MANURE CROP—SEASON 1923

The 4 plots involved in this experiment have been in wheat and rye since 1909 (1909 to 1923, inclusive).

One plot is seeded to wheat and one to rye each year without a legume cover crop and without nitrogenous fertilizers. Also, each year one wheat and one rye plot grow a green-manure crop (soybeans) between wheat harvest and wheat seeding. No farm manure or commercial nitrogenous fertilizer is applied to these plots. All the plots, however, receive annual applications of acid phosphate and muriate of potash and all are limed at intervals of 5 years.

In recent years volunteer clover has been coming into the 2 non-legume plots to such an extent as materially to influence the results. Thus the yields of wheat and rye on these plots are more and more approaching the yields on the legume plots, with the result that the latter apparently are not now showing a very great increase over the non-legume plots.

This appearance of volunteer clover is inevitable where the soil is naturally well drained and where lime and minerals are used in liberal amounts, and goes to show that clover may be grown with little difficulty if only the conditions are made favorable for it.

Crop of 1923

The wheat and rye were harvested about the last of June, 1922, and on the first of July soybeans were drilled on plots 70 and 71. Germination was good and the beans made good growth throughout the season, though considerable crab grass appeared later. They were plowed under September 9, plots 68 and 69 also being plowed at this time.

Reference has already been made to volunteer clover which appeared on plots 68 and 69 following the wheat and rye. The clover came in again this year on plot 68 to such an extent that there was

a fair stand. Plot 69 was disced when plots 70 and 71 were being prepared for soybeans, thus the growth of clover on this plot was checked.

Without question this clover had a marked influence on the wheat and rye crop of 1923. On October 2 Leap's prolific wheat was seeded on plots 69 and 71 and rye on plots 68 and 70. A good, even stand was secured. There appeared to be little difference in growth between the wheat plot without soybeans and the one with soybeans.

TABLE 1

Rye and Wheat Grown With and Without a Legume Green-Manure Crop—Season 1923. (Calculated to Acre Basis)

Plot No.	SPECIAL TREATMENT	Grain			Straw			
		Dry Matter	Nitrogen	Nitrogen	Dry Matter	Nitrogen*	Nitrogen	Total Nitrogen
		lbs.	*per cent*	*lbs.*	*lbs.*	*per cent*	*lbs.*	*lbs.*
68	Rye alone	1525	1.752	26.72	4535	.372	16.87	43.59
70	Rye followed by soybeans..	1250	1.524	19.05	3380	.418	14.13	33.18
69	Wheat alone...	1750	1.745	30.54	3160	.480	15.17	45.71
71	Wheat followed by soybeans..	1475	1.815	26.77	2685	.509	13.67	40.44

*Nitrogen not determined in straw this year; figures used are the 14-year averages for the respective plots.

The rye plot without soybeans, 68, appeared to be slightly better than the one with soybeans. This was probably due to the effect of the volunteer clover referred to above. The grain was harvested about the last of June, weighed and samples dried and prepared for analysis. In the case of the wheat the entire amount from both plots was threshed and weighed. One-fifth of the rye was threshed and weighed. The yields calculated to the acre basis, together with the per cent of nitrogen and the total nitrogen, are shown in table 1.

In striking contrast with results for previous years, the yields on the wheat and rye plots without the soybeans were in each case larger by 275 pounds per acre than those on the soybean-treated plots. As already intimated, this change was, no doubt, due to the volunteer clover on plots 68 and 69.

The percentage of nitrogen in the rye grain is somewhat less for the soybean-treated plot than for the plot without soybeans. The reverse is true on the wheat plots. As explained in the footnote, the

percentage of nitrogen in the straw was not determined, and in order that the total yield of nitrogen for the different plots might be approximated, the 14-year average percentage of nitrogen in the straw for the respective plots was used as the analysis for this crop. This would probably introduce only a slight error. The total nitrogen in each instance is in conformity with the yields—that is, the yield of nitrogen is lowest on the soybean-treated plots.

TABLE 2

Percentage of Nitrogen in Rye and Wheat-Grain and Straw—Grown on the Same Land Year After Year—1909-1922

YEAR	Rye alone		Rye followed by soybeans		Wheat alone		Wheat followed by soybeans	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
1909	1.570	.250	1.610	.300	2.010	.480	1.950	.510
1910	1.707	.355	1.774	.309	1.790	.411	1.909	.426
1911	1.870	.383	1.680	.403	2.110	.516	2.140	.543
1912	1.620	.330	1.430	.298	1.750	.375	1.670	.394
1913	1.621	.324	1.698	.372	2.137	.620	2.213	.467
1914	1.466	.324	1.542	.359	1.972	.578	1.963	.570
1915	1.900	.344	2.146	.443	2.096	.364	2.205	.394
1916	1.860	.392	1.961	.547	2.143	.611	2.180	.648
1917	2.048	.473	2.235	.561	2.304	.552	2.511	.719
1918	1.779	.449	2.013	.506	2.050	.487	2.359	.665
1919	1.760	.576	1.740	.365	2.055	.468	1.986	.519
1920	1.816	.322	1.960	.334	2.100	.434	2.160	.414
1921	1.875	.319	1.972	.326	2.575	.385	2.553	.342
1922	1.700	.360	2.050	.729	1.810	.432	2.120	.513
Average ..	1.756	.372	1.842	.418	2.064	.480	2.137	.509

Percentage of Nitrogen in Grain and Straw for Fourteen Years

In connection with the nitrogen figures given above it is of interest to study the figures in table 2, showing the percentage of nitrogen in the grain and straw from the 4 plots for the 14 years ending with the 1922 crop.

It is to be noted that in the case of each crop, and for both grain and straw, the average percentage of nitrogen is slightly higher for the soybean-treated plot than for the plot without soybeans.

The samples of rye grain show an extreme variation of 0.81 per cent, but the average difference for the two treatments is only about

0.10 per cent. The percentage of nitrogen in the wheat grain shows an extreme variation of 0.84 per cent with an average difference for the two treatments of only 0.07 per cent. In this case a large number of the samples contained when analyzed very close to 2 per cent nitrogen. The average for all the rye straw closely approximates 0.4 per cent and for all the wheat straw 0.5 per cent. The average figure for the wheat straw is the same as the figure given in Van Slyke's table [1]. However, there is considerable variation from year to year in each case. This may be due to seasonal difference.

The average for the rye straw is 0.1 per cent lower than Van Slyke's figure.

THE CONTINUOUS GROWING OF CORN WITH A LEGUME AND NON-LEGUME GREEN-MANURE CROP—SEASON 1923

The experiment with green manure crops, in connection with the use of small quantities of farm manure in the continuous growing of corn, has been continued, the season of 1923 completing the sixteenth year.

The special treatment for the different plots is indicated in table 3. In addition to the special treatment, each plot received, per acre, 300 pounds of acid phosphate, 100 pounds of muriate of potash, 80 pounds of nitrate of soda and 60 pounds of sulfate of ammonia (equivalent to 160 pounds of nitrate of soda per acre).

The cover crops were seeded about July 20, 1922, a mixture of vetch and clovers on plots 49 to 52 and rye on plots 53 to 56.

Germination was good and the crops made fair growth during the fall. Notes taken May 1, 1923, state that there was a fair cover of vetch and clover, 3 to 6 inches high, on plots 49 to 52, and a rather thin crop of rye on plots 53 to 56.

The land was plowed for corn May 1, and the manure and fertilizer applied as above. Also lime in the form of ground oyster shells was applied at the rate of 2 tons per acre.

White cap yellow dent corn was planted May 18. A good stand was secured and growth through the season was normal. The fall cover crops were seeded later than usual on account of dry weather and the corn harvested September 11. After standing in the shocks for some time the corn was weighed and samples dried and prepared for analysis in the usual way.

The yields calculated to the acre basis, together with the percentage of nitrogen and total nitrogen in grain, cobs and stalks, are reported in table 3.

[1] Van Slyke, L. L. 1912. Fertilizers and Crops, p. 720. Orange Judd Co.

Continuous Corn With Legume and Non-Legume Crop—1923
(Calculated to the Acre Basis)

SPECIAL TREATMENT	Grain			Cobs			Stalks			
	Dry Matter	Nitrogen	Nitrogen	Dry Matter	Nitrogen	Nitrogen	Dry Matter	Nitrogen	Nitrogen	Total Nitrogen
	lbs.	*per cent*	*lbs.*	*lbs.*	*per cent*	*lbs.*	*lbs.*	*per cent*	*lbs.*	*lbs.*
LEGUME SECTION										
No manure	2775	1.591	44.15	495	.284	1.41	3131	.704	22.04	67.60
50 lbs. manure	2325	1.550	36.04	455	.252	1.15	2675	.963	25.76	62.95
100 lbs. manure	2560	1.597	40.88	448	.246	1.10	2539	.884	22.44	64.42
200 lbs. manure	2853	1.550	44.22	483	.278	1.34	2993	.899	26.91	72.47
Average	2628	1.572	41.32	470	.265	1.25	2835	.863	24.29	66.86
NON-LEGUME SECTION										
No manure	1805	1.340	24.19	313	.284	0.89	2719	.552	15.01	40.09
50 lbs. manure	2230	1.347	30.04	410	.221	0.91	2887	.530	15.30	46.25
100 lbs. manure	2403	1.315	31.60	425	.252	1.07	2811	.546	15.35	48.02
200 lbs. manure	2318	1.347	31.22	418	.294	1.23	2914	.735	21.42	53.87
Average	2189	1.337	29.26	392	.263	1.03	2833	.591	16.77	47.06

Comparison of Legume and Non-Legume Plots

The average yield of shelled corn for the legume section was at the rate of 2,628 pounds per acre (47 bushels) and the average for the non-legume section 2,189 pounds per acre (39 bushels), a difference of 8 bushels in favor of the legume section. The yield of stalks was practically the same on the two sections. The average percentage of nitrogen in the grain from the legume section is 1.57 as against 1.34 for the non-legume section, and for stalks .863 per cent for the legume section and .591 for the non-legume section.

There is an average difference in total nitrogen of nearly 20 pounds per acre in favor of the legume section.

The Influence of the Manure

For the legume section the yield of grain on the check plot exceeded the yield on the plots that receive manure at the rate of ½ ton and 1 ton per acre, and was almost as large as the yield on the plot that receives 2 tons of manure. It is quite evident that the cover crop on the check plot has, to an extent, compensated for the lack of manure.

For the non-legume section the check plot gave the lowest yield of grain and total nitrogen, while the plot that receives 1 ton of manure gave the highest yield of grain, and the one with 2 tons of manure the highest yield of stalks and total nitrogen. While the yields are smaller on the non-legume than on the legume section, the influence of the manure is more easily noted on the former than on the latter. Apparently, the manure has had no influence on the percentage of nitrogen in the dry matter.

SEVEN YEARS OF COOPERATIVE FERTILIZER EXPERIMENTS WITH POTATOES

For many years potatoes have been an important crop for New Jersey. A comparatively large area of land in the state is well adapted to this crop, and marketing conditions are, perhaps, more favorable than in any other section of the country. There is, therefore, good reason why many New Jersey farmers should be engaged in the business of growing potatoes.

The development of the commercial fertilizer industry, which has come about largely during the last 40 years, has greatly stimulated interest in this crop.

This condition is reflected in the average yields for the state for the last 40 years. From 1880 to 1900 the average yield was about 86 bushels. Since 1900 the yields, according to the United States

Census and Department of Agriculture Yearbook, have been as follows:

	bu.
1909	110
1919	125
1920	156
1921	95
1922	173
1923*	96

*Preliminary estimate.

During this period a great many fertilizer experiments have been carried out, with the result that potato farmers, as a class, are well informed on this subject. However, there are a number of points on which there is not yet general agreement.

Early in 1917, when efforts were being made to speed up food production, some of the growers in south Jersey requested that experiments be conducted to determine more accurately the relative value of organic nitrogenous fertilizers, special emphasis being laid upon the relative value of ground fish scrap and tankage. In order that specific information might be had on this and other points, it was decided that the experiment station should cooperate with one of the growers in conducting such an experiment.

After careful consideration the experiment was located on the farm of J. Harry Kandle, about 4 miles south of Elmer, on the Bridgeton road.

The soil is a rather heavy loam belonging to the Sassafras series, and of slightly better quality than the average soil of this type. The land had been used for general farm crops, and a year or two before this work was started had been limed, but the lime treatment was heavier in some places than in others. This was unfortunate in that it complicated the problem, when it was discovered later that the soil was badly infected with scab fungus.

The plan of the experiment, as finally developed, provided for the study of the following points:

1. Different amounts of a so-called standard fertilizer (4 per cent nitrogen, 8 per cent phosphoric acid and 3 per cent potash).
2. A comparison of 4 different nitrogenous materials, each used as the sole source of nitrogen and also in combinations, so that the nitrogen called for in the formula was obtained from two or more sources.
3. A trial of the standard mixture without potash and with potash at the rate of 3, 6 and 10 per cent.
4. The substitution of greensand marl for soluble potash salts.
5. The use of finely-ground limestone.

A later development of the problem has been the study of the influence of the fertilizer on the soil reaction and on the development of the fungus scab.

The plot of ground allotted for this work was laid out as indicated in figure 1. The plots are $^{1}/_{100}$ acre in size, and, with a few exceptions, are duplicated, plots 25 to 48 being a repetition of plots 1 to 24.

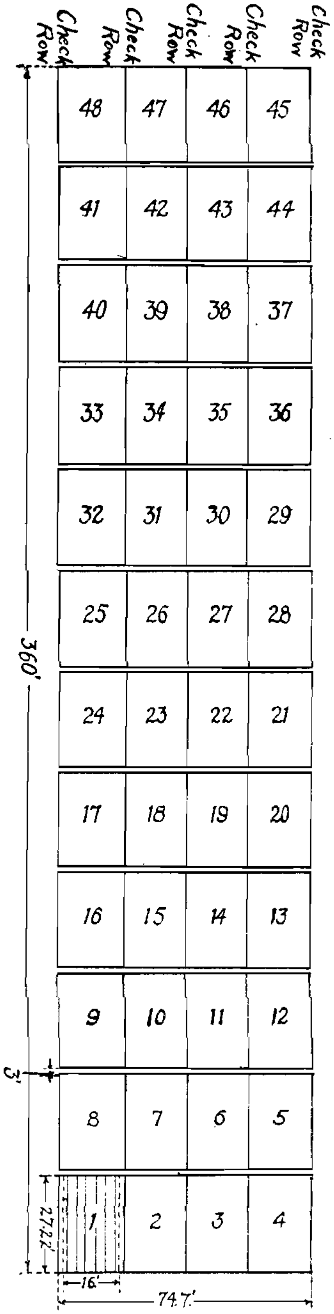


FIG. 1. Plan of cooperative fertilizer experiment with potatoes.

Plots 1, 10, 21 and 41 were left as checks—that is, untreated throughout the period. A check row was left on the two sides of the main block and also between the blocks of plots running lengthwise, making 5 check rows in all. A space of 3 feet was left between the blocks crosswise. The rows were 32 inches apart. The fertilizers were weighed and mixed at the experiment station and were applied in the row by hand just before planting.

The so-called standard fertilizer was made as follows:

Nitrogen:
- ¼ from nitrate of soda
- ¼ from ammonium sulfate
- ½ from tankage

Phosphoric acid from 16 per cent acid phosphate
Potash from 50 per cent muriate of potash.

The standard application was 1,600 pounds to the acre, but it was also used in varying amounts, from 800 pounds to 2,800 pounds, by 400-pound increments. The marl was finely ground and was applied at the rate of 5,000 pounds per acre for the first crop. No additional applications of marl have been made.

After harvesting the potatoes it has been customary to seed a cover crop of wheat or rye. In 1918, through an error, clover was seeded. (When a test is being made of the relative availability of different nitrogenous materials a legume crop cannot consistently be grown.)

Planting, cultivating, spraying, etc., have been carried out in accordance with methods used in Salem County. At digging time the potatoes from each plot were graded and weighed separately.

The work has not all been smooth sailing. There have been dry seasons and wet seasons, and sometimes poor stands; scab fungus and other diseases have combined to complicate the results. The net results, however, undoubtedly throw some light on the problem.

The figures reported in table 4 indicate total yields rather than "primes" and "seconds," for the reason that the grading in 1917, 1918 and 1919 was not as uniform as it should have been.

The total yields for the 7 years, 1917 to 1923, inclusive, are shown in table 4. It will be noted, however, that the yields for 1923 have not been included in the averages. This omission has been made on account of the unusually low yields in 1923, due partly to weather conditions and partly to disease conditions.

A study of the table brings out a number of interesting facts. In the first place, excepting the crop for 1923, which, as previously explained, was abnormally low, there is no indication of a general decline in yield. Indeed, the averages for the 3 years, 1920 to 1922, inclusive, are, in most cases, larger than the averages for the first 3 years. This would indicate that it is possible to grow potatoes successively for a period of years with a fair degree of success.

The 6-year average for the 4 check plots is 166 bushels per acre, which is 81 bushels less than the average for the 4 plots that have received the standard treatment, namely, 1,600 pounds per acre of a

TABLE 4

Total Yields of Potatoes for the Years 1917-1923, Inclusive (Calculated to Acre Basis)

Plot Nos.	Pounds Fertilizer per Acre	1917	1918	1919	1920	1921	1922	1923 ‡	6-year Aver.
		bu.	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*
1, 10, 21 & 41	No fertilizer (Check)	220	164*	180	174	104	151	27.1	166
2 & 25	800 lbs. 4-8-3	255	216	196	265	142	218	47.5	214
3 & 26	1200 lbs. 4-8-3	276	238	205	324	146	240	48.4	238
4, 18, 27 & 40	1600 lbs. 4-8-3 (Standard)	285	238	210	334	160	257	60.8	247
5 & 28	2000 lbs. 4-8-3	291	244†	240	341	169	266	60.9	259
6 & 29	2400 lbs. 4-8-3	318	249	255	362	173	286	62.5	274
7 & 30	2800 lbs. 4-8-3	312	262	269	372	170	273	76.7	276
8 & 31	1600 lbs. 4-8-3 all Nitrogen from Nitrate	288	236	228	337	167	238	67.5	249
9 & 32	1600 lbs. 4-8-3 all Nitrogen from Ammonium Sulfate	276	211	172	292	132	218	48.3	214
11 & 33	1600 lbs. 4-8-3 all Nitrogen from Fish	277	226	219	345	153	257	62.5	246
12 & 34	1600 lbs. 4-8-3 all Nitrogen from Tankage	265	230	212	340	158	260	60.0	244
13 & 35	1600 lbs. 4-8-3 ½ Nitrogen from Nitrate, ½ Ammonium Sulfate	315	218	217	358	159	275	49.2	257
14 & 36	1600 lbs. 4-8-3 ½ Nitrogen from Nitrate, ½ Fish	309	227	224	357	167	267	64.2	259
15 & 37	1600 lbs. 4-8-3 ½ Nitrogen from Nitrate, ½ Tankage	295	237	238	359	159	268	65.0	259
16 & 38	1600 lbs. 4-8-3 ¼ Nitrogen from Nitrate, ¼ Ammonium Sulfate, ½ Fish	279	230	223	340	146	243	60.9	244

TABLE I—Continued

Total Yields of Potatoes for the Years 1917-1923, Inclusive (Calculated to Acre Basis)

Plot Nos.	Pounds Fertilezer per Acre	1917	1918	1919	1920	1921	1922	1923 ‡	6-year Aver.
		bu.	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*
17, 39 & 45	1600 lbs. 4-8-0	241	206	198	275	127	220	56.1	211
4, 18, 27 & 40	1600 lbs. 4-8-3 (Standard)	285	238	210	334	160	2 7	60.8	247
19 & 42	1600 lbs. 4-8-6	295	244	207	384	153	248	63.4	255
20 & 43	1600 lbs. 4-8-10	277	218	236	358	162	273	62.5	259
22, 23, 44 & 46	1600 lbs. 4-8-0 & 2½ tons finely ground Greensand Marl	269	233	209*	336	137	246	51.3	238
24	1600 lbs. 4-8-0 & 2 tons Ground Limestone	239	171	183	233	121	198	43.3	191
48	2 tons Ground Limestone only.........	158	145	186	189	117	175	21.6	162

*Average for 3 plots.
†One plot only.
‡Omitted from average.

4-8-3. It would be a very poor market year when 81 bushels would not be a good return for 1,600 pounds of fertilizer. The highest average yield—276 bushels per acre—was with 2.800 pounds of the standard mixture. This is 110 bushels better than the average for the check plots, but only 2 bushels more than the average for the 2,400-pound application. It is at once evident that the increase from 2,400 to 2,800 pounds did not give an adequate return. Twenty-four hundred pounds gave an average increase of 15 bushels over the 2,000-pound application. With good prices this would be a profitable return.

These results, however, cannot definitely answer the question as to how much fertilizer should be applied, since there are several factors to be taken into consideration. Among these may be mentioned the type of soil, cost of fertilizers, and, especially, the market price of potatoes. All of these must be carefully considered in connection with the question of the amount of fertilizers to apply. It may be further pointed out that the 6-year average shows a gradual increase from 214 bushels with 800 pounds of the 4-8-3 to 276 bushels with 2,800 pounds.

The average yields, with three of the nitrogenous materials used singly, are fairly close. The yield with ammonium sulfate is, however, 30 bushels per acre less than the lowest yield with the other three materials. However, this loss was probably more than compensated for by the reduction in scab injury on the ammonium sulfate plots. It is now well understood that this material has a tendency to increase the acidity of the soil and thus reduce the injury from scab. On the other hand, the nitrate of soda has the opposite effect, and, as might be expected, the potatoes from the nitrate plots were very much injured by the scab. It must not be understood, however, that all of the scab injury was due to the fertilizer treatment. It was already in the soil, and the uneven distribution of the lime, previous to the starting of this work, made it very difficult to tell just what effect some of the fertilizer treatments had in this respect.

It is significant that, when half the nitrogen was taken from nitrate of soda and half from one of the other materials, the yields were distinctly larger than when the materials were used singly. In explanation of this, it is suggested that the readily available nitrate may give the plant a good start in the early stages of its development, and on this account it utilizes, to better advantage, the other nitrogenous materials. When only ¼ of the nitrogen was taken from nitrate, the amount of application being kept uniform, the yields were not so good.

With 1,600 pounds of 4-8-0, the average yield was 211 bushels, whereas, with an equal amount of 4-8-3, 4-8-6 and 4-8-10, the yields were 247, 255 and 259 bushels per acre, respectively. Under normal conditions, the increase over the 4-8-0 would, in all cases, more than pay for the potash. The 4-8-10 gave an average increase of only 4 bushels over the yield with 4-8-6, and from this it would appear that on this, or similar types of soil, 6 per cent of potash is about all that is needed when the application is as much as 1,600 pounds per acre.

The greensand marl as a source of potash has given a 6-year average of 238 bushels, which is a fair increase over the yield with an equal amount of 4-8-0. It must be remembered, however, that the amount of marl used, 5,000 pounds per acre, is an unusually heavy application, and would, probably, be more expensive in the end, as a source of potash, than a fertilizer containing 5 or 6 per cent of soluble potash. Furthermore, it should be stated that the potatoes on the marled plots have, in most cases, been exceedingly scabby.

There is not much to be said with reference to the limestone; when used with 4-8-0 the yield was less than the yield with the 4-8-0 alone, and when used alone the yield was less than the yield on the check plots, and the potatoes were small and scabby.

Brief attention may be called to table 5, which reports both totals and seconds for the 3 years, 1920, 1921 and 1922, and the average totals, seconds and primes for the 3 years. In a few instances the relative standings, as compared with the 6-year averages, have been slightly changed. With the increasing amount of fertilizer the average yields increase gradually up to and including the 2,400-pound application.

The 3-year averages for the tankage and fish used singly are slightly above the 3-year average for the nitrate of soda. This may be due to the cumulative effect of the organic material. The mixtures containing ½ nitrogen from nitrate and ½ from other sources continue to give the highest yields when the other factors are kept constant.

For the potash treatment the 3-year averages do not differ greatly from the 6-year averages. When "primes" alone are considered the average is slightly better with 6 per cent of potash than with 10 per cent.

THE INFLUENCE OF LIME ON SOYBEANS

Only 8 varieties of soybeans were grown in 1923. This is the eleventh year of the continuous growing of soybeans on the same land.

Plot R, which had not been limed up to this time, and which had almost ceased to grow beans, was limed at the rate of 4,000 pounds of ground oyster shell per acre, and half the plot seeded to Haberlandt and half to Baird soybeans. The yields and nitrogen data from these plots, as well as from plots O, P and Q, are shown in table 6.

The varieties, Swan, Austin, Virginia and Wilson, all gave yields of over 800 pounds per acre. Plot R yielded 618 and 676 pounds per acre of Haberlandt and Baird, respectively. This is a remarkable improvement over the small yields of 1922 (less than 5 bushels per acre), and must be credited largely to the application of lime already mentioned.

The total nitrogen recovered in beans and vines from this plot amounts to nearly 50 pounds per acre, whereas in 1922 it amounted to only about 18 pounds per acre. The highest yield of total nitrogen was 70.8 pounds with Swan on plot O.

TABLE 5

Showing "Totals" and "Seconds," and "Primes" by Difference, for the Years 1920, 1921 and 1922

Plot Nos.	Fertilizer per Acre	1920		1921		1922				
		Total	Seconds	Total	Seconds	Total	Seconds	Average Totals	Average Seconds	Average Primes
		bu.	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*
1, 10, 21 & 41	No fertilizer (Check)	174	28	104	34	151	29	143	30	113
2 & 25	800 lbs. 4-8-3	265	29	142	44	218	18	208	30	178
3 & 26	1200 lbs. 4-8-3	324	37	146	49	240	32	237	39	198
4, 18, 27 & 40	1600 lbs. 4-8-3 (Standard)	334	35	160	46	257	30	250	37	213
5 & 28	2000 lbs. 4-8-3	341	30	169	50	266	28	259	36	223
6 & 29	2400 lbs. 4-8-3	362	25	173	40	286	31	274	32	242
7 & 30	2800 lbs. 4-8-3	372	25	170	40	273	29	272	31	241
8 & 31	1600 lbs. 4-8-3 { all Nitrogen from Nitrate	337	36	167	47	238	33	247	39	208
9 & 32	1600 lbs. 4-8-3 { all Nitrogen from Ammonium Sulfate..	292	37	132	35	218	19	214	30	184
11 & 33	1600 lbs. 4-8-3 { all Nitrogen from Fish	345	36	153	41	257	32	252	36	216
12 & 34	1600 lbs. 4-8-3 { all Nitrogen from Tankage	340	30	158	45	260	32	253	36	217

TABLE 5—Continued

Showing "Totals" and "Seconds," and "Primes" by Difference, for the Years 1920, 1921 and 1922

Plot Nos.	Pounds Fertilizer per Acre	1920		1921		1922				
		Total	Seconds	Total	Seconds	Total	Seconds	Average Totals	Average Seconds	Average Primes
		bu.	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*
13 & 35	1600 lbs. 4-8-3 { ½ Nitrogen from Nitrate, ½ Ammonium Sulfate	358	27	159	48	275	33	264	36	228
14 & 36	1600 lbs. 4-8-3 { ½ Nitrogen from Nitrate, ½ Fish...	357	34	167	52	267	36	264	41	223
15 & 37	1600 lbs. 4-8-3 { ½ Nitrogen from Nitrate, ½ Tankage	359	35	159	52	268	33	262	40	222
16 & 38	1600 lbs. 4-8-3 { ¼ Nitrogen from Nitrate, ¼ Ammonium Sulfate, ½ Fish	340	33	146	41	243	28	243	34	209
17, 39 & 45	1600 lbs. 4-8-0	275	29	127	37	220	29	207	32	175
4, 18, 27 & 40	1600 lbs. 4-8-3 (Standard)	334	34	160	46	257	30	250	37	213
19 & 42	1600 lbs. 4-8-6	384	29	153	40	248	22	262	30	232
20 & 43	1600 lbs. 4-8-10	378	28	162	43	273	28	264	33	231
22, 23, 44 & 46	{ 1600 lbs. 4-8-0 & 2½ tons finely ground Greensand Marl	336	35	137	39	246	30	240	35	205
24	{ 1600 lbs. 4-8-0 & 2 tons Ground Limestone	233	28	121	45	198	35	184	36	148
48	2 tons Ground Limestone only.........	189	17	117	37	175	43	160	32	128

Judging from the results in this experiment, it seems fair to conclude that it is possible to grow soybeans on the same land successfully for a considerable period of years if lime is used in quantities sufficient to maintain the reaction close to the neutral point.

Another point of interest is the quick response and recovery which the beans show when lime is applied to land that has become quite acid.

TABLE 6

The Influence of Lime on the Yield and Nitrogen Content of Soybeans—1923

(Calculated to the Acre Basis)

Plot No. *and Variety*	Hulled Beans (Dry)			Vines			
	Beans	Nitrogen	Nitrogen	Dry Matter	Nitrogen	Nitrogen	Total Nitrogen
	lbs.	*per cent*	*lbs.*	*lbs.*	*per cent*	*lbs.*	*lbs.*
Plot O							
Manchu	772	6.296	48.61	1028	.647	6.65	55.26
Swan	948	6.959	65.97	772	.625	4.83	70.80
Plot P							
Austin	898	6.612	59.38	1182	.641	7.58	66.96
Virginia	852	6.495	55.34	1148	.625	7.18	62.52
Plot Q							
Elkton	654	6.833	44.69	546	.679	3.71	48.40
Wilson	828	6.101	50.52	972	.609	5.92	56.44
Plot R							
Haberlandt	618	6.821	42.15	742	.736	5.46	47.61
Baird	676	6.969	47.11	604	.745	4.50	51.61

Although all of the crops have been removed, and no commercial nitrogen or manure has been applied to these plots for more than 10 years, analysis of the soil shows that they contain as much nitrogen as nearby plots on which non-legume crops have been grown, and to which nitrate of soda has been applied at the rate of 320 pounds per acre annually.

The work would seem to justify the conclusion that soybeans may be grown on the same land year after year without the use of nitrogenous fertilizers, and the crop removed without seriously depleting the supply of soil nitrogen. On the other hand, it is important that the lime, phosphate and potash be applied at regular intervals to make good the losses through leaching and the removal of crops.

INFLUENCE OF SULFUR ALONE AND IN COMBINATION WITH ROCK PHOSPHATE ON PLANT GROWTH

J. G. LIPMAN and H. C. McLEAN

Experiments which have been carried out by the New Jersey Experiment Station have shown that:

1. Sulfur is oxidized rapidly in soils if sulfur-oxidizing microorganisms are present. This oxidation leads to the formation of sulfuric acid which readily reacts with basic substances.
2. Under proper conditions, when a mixture of inoculated sulfur, ground rock phosphate and soil are composted, a large percentage of the inert phosphorus is made available in a few weeks time.

Dr. J. G. Lipman has suggested that it might not be necessary to compost the sulfur and rock phosphate before applying them to the land, but that they might be thoroughly mixed and applied to the soil at once.

The soil would thus become an acid phosphate factory, in that the sulfur would be oxidized to sulfuric acid, which would, in turn, react with the phosphate rock converting it into available acid phosphate. Preliminary experiments* reported in 1921 indicated that this method of fertilization might be feasible.

In order to secure more data on this subject, 10 experiments were started on the more prominent types of soil in different sections of New Jersey. The results obtained were inconclusive for the 10 different crops grown. The results, however, do indicate that a mixture of 20 parts of sulfur and 80 parts ground prosphate rock would satisfy the phosphate requirements of sweet potatoes, provided a small initial application of acid phosphate was made in order to supply the immediate requirements of the young plants. The third year of experiments on plots thus treated is now in progress.

In order to secure data on some crops under more controlled conditions. several experiments were started in the greenhouse using different soils and crops. Tables 7, 8, 9 and 10 give results thus obtained in the Elsinboro fine sand, Penn loam and Coltsneck loam. The soils used in the experiments reported in tables 7 and 8 had been cropped since 1907 without addition of fertilizers. The Coltsneck loam is a soil containing .772 per cent of P_2O_5 and 25.18 per cent

---

*Lipman, J. G., et al., 1921. Inoculated Sulfur as a Plant-Food Solvent. *In* Soil Sci., v. 11, p. 87-92.

TABLE 7

Yield of Barley and Amounts of Phosphorus Taken Up by the Plants Grown in Elsinboro Fine Sand

SPECIAL TREATMENT (Calculated to acre basis)	Dried Blood			Sodium nitrate			Ammonium sulfate			Average of Three Treatments	
	Dry weight of crop		Average P_2O_5 taken up	Dry weight of crop		Average P_2O_5 taken up	Dry weight of crop		Average P_2O_5 taken up	Weight of crops	P_2O_5 taken up
	gm.	*Average gm.*	*mgm.*	*gm.*	*Average gm.*	*mgm.*	*gm.*	*Average gm.*	*mgm.*	*gm.*	*mgm.*
100 lbs. sulfur	9.60			10.35			10.65				
100 lbs. sulfur	7.75	8.68	64.14	12.45	11.40	64.92	11.55	11.10	69.60	10.39	66.22
400 lbs. rock phosphate	7.60			12.25			10.23				
400 lbs. rock phosphate	7.92	7.76	57.55	11.95	12.10	73.45	9.75	9.99	58.31	9.95	63.10
500 lbs. acid phosphate	9.23			12.25			11.10				
500 lbs. acid phosphate	8.65	8.94	69.96	12.90	12.58	80.07	10.85	10.98	66.33	10.84	72.12
100 lbs. sulfur 400 lbs. rock phosphate	9.00			11.26			11.25				
100 lbs. sulfur 400 lbs. rock phosphate	9.00	9.00	68.36	13.27	12.24	74.24	11.95	11.60	73.04	10.95	71.88
100 lbs. sulfur 500 lbs. acid phosphate	8.55			12.47			11.00				
100 lbs. sulfur 500 lbs. acid phosphate	8.70	8.63	69.58	12.15	12.31	77.57	11.21	11.11	77.16	10.66	74.77
No sulfur or phosphorus	8.70			11.75			11.30				
No sulfur or phosphorus	8.82	8.76	56.44	12.85	12.30	71.46	10.95	11.13	65.08	10.73	64.33
200 lbs. sulfur 400 lbs. rock phosphate	9.33										
200 lbs. sulfur 400 lbs. rock phosphate	9.20	9.27	68.46								

TABLE 8

Yield of Barley and Amount of Phosphorus Taken Up by the Plants Grown in Sassafras Loam Soil

TREATMENT (Calculated to acre basis)	Weight of crop		Phosphorus in plants		
			P_2O_5	P_2O_5 taken up	Average P_2O_5 taken up
	gm.	*Average gm.*	*per cent*	*mgm.*	*mgm.*
Check, dried blood	4.75	....	.4783	22.72	....
Check, dried blood	5.00	4.88	.4737	23.69	23.21
100 lbs. sulfur, dried blood	4.47	....	.4853	21.69	....
100 lbs. sulfur, dried blood	4.75	4.61	.4130	19.62	20.66
400 lbs. rock phosphate, dried blood	4.27	....	.4875	20.82	....
400 lbs. rock phosphate, dried blood	5.50	4.89	.4562	25.09	22.96
500 lbs. acid phosphate, dried blood	6.88	....	.4967	34.17	....
500 lbs. acid phosphate, dried blood	6.45	6.67	.4574	29.52	31.85
100 lbs. sulfur, 400 lbs. rock phosphate, dried blood	5.30	....	.3670	19.45	....
100 lbs. sulfur, 400 lbs. rock phosphate, dried blood	5.30	5.30	.4406	23.35	21.40
100 lbs. sulfur, 500 lbs. acid phosphate, dried blood	6.20	....	.4399	27.27	....
100 lbs. sulfur, 500 lbs. acid phosphate, dried blood	6.20	6.20	.5203	32.26	29.77
Check, sodium nitrate	5.65	....	.4958	28.01	....
Check, sodium nitrate	5.90	5.78	.4239	25.01	26.51
100 lbs. sulfur, sodium nitrate	5.85	....	.4047	23.67	....
100 lbs. sulfur, sodium nitrate	5.93	5.89	.3495	20.53	22.10
400 lbs. rock phosphate, sodium nitrate	6.20	....	.4461	27.66	....
400 lbs. rock phosphate, sodium nitrate	6.37	6.29	.4666	29.72	28.69
500 lbs. acid phosphate, sodium nitrate	6.72	....	.4016	26.99	....
500 lbs. acid phosphate, sodium nitrate	6.75	6.74	.4059	27.40	27.19
100 lbs. sulfur, 400 lbs. rock phosphate, sodium nitrate	6.25	....	.3787	23.67	....
100 lbs. sulfur, 400 lbs. rock phosphate, sodium nitrate	5.84	6.05	.3189	18.62	21.15
100 lbs. sulfur, 400 lbs. acid phosphate, sodium nitrate	7.45	....	.4200	31.29	....
100 lbs. sulfur, 400 lbs. acid phosphate, sodium nitrate	7.85	7.65	.4967	38.99	35.14

Fe_2O_3. This soil was used in order to study the influence of the sulfur in rendering the original content of phosphorus available to the crops as well as the sulfur-rock phosphate mixture. In the experiments reported in tables 7 and 8 all pots received a general application of potassium sulfate at the rate of 200 pounds per acre. Nitrogen equivalent to 1 gm. of dried blood per pot was applied. In the case of the experiment reported in table 9, 1 gm. of potassium chloride and 1 gm. of ammonium sulfate were added per 10-pound pot of soil. In this case the treatments were carried out in triplicate, and, therefore, the results given are the average of the 3 pots in each case.

TABLE 9

Influence of Sulfur on the Availability of Phosphates in Colts Neck Loam Soil as Measured by Yields of Oats

SPECIAL TREATMENT	Unlimed				Limed (2000 lbs. $CaCo_3$ per Acre)			
	Total weight of crop	Straw	Grain	pH of soil	Total weight of crop	Straw	Grain	pH of soil
	gm.	*gm.*	*gm.*		*gm.*	*gm.*	*gm.*	
None	50.73	33.15	17.58	6.65	44.78	27.93	16.85	6.8
0.56 gm. sulfur	49.35	33.05	16.30	6.55	49.18	32.93	16.25	6.75
2.0 gm. rock phosphate	47.13	31.60	15.53	6.65	50.63	35.25	15.38	6.85
1.0 gm. acid phosphate	47.55	31.27	16.28	6.75	43.30	36.35	16.95	6.75
0.56 gm. sulfur, 2.0 gm. rock phosphate	46.23	29.98	16.25	6.5	44.20	28.47	15.73	6.7
1.0 gm. sulfur	46.63	32.03	14.60	6.5	47.13	31.58	15.55	6.65
1.0 gm. sulfur, 2.0 gm. rock phosphate	48.40	31.92	16.48	6.4	46.65	30.30	16.35	6.65
0.50 gm. $CaSO_4$, 2.0 gm. rock phosphate	44.48	29.65	14.83	6.5	42.18	27.95	14.23	6.75

Moisture was maintained at optimum throughout the growing period At maturity the plants were harvested, dried and weighed. Determinations were made of the hydrogen-ion concentration of the soils at this time.

The crops from the Elsinboro and Sassafras soils were analyzed for phosphorus.

The Sassafras loam soil appears to be the only one giving a consistent response to phosphorus as measured by the crop yield. The acid phosphate increased the yield of barley, but the phosphate rock, or phosphate rock-sulfur mixture, did not affect the yield one way or the other as compared with the check.

TABLE 10

Influence of Sulfur on the Availability of Rock Phosphate in Sassafras Loam Soil

Pot No.	SPECIAL TREATMENT (in pounds per acre)	Dry weight of barley		Increase over Nos. 1 & 2 and 13 & 14	pH of soils
		gm.	*Average gm.*		
1	Check, (dried blood)	9.75	....	....	6.50
2	Check, (dried blood)	9.40	9.58	....	6.60
3	100 lbs. sulfur, dried blood	9.15	....	....	6.30
4	100 lbs. sulfur, dried blood	9.45	9.30	....	6.55
5	400 lbs. rock phosphate, dried blood	9.60	....	....	6.7
6	400 lbs. rock phosphate, dried blood	10.05	9.83	.25	6.6
7	500 lbs. acid phosphate, dried blood	11.85	....	....	6.50
8	500 lbs. acid phosphate, dried blood	11.25	11.55	1.97	6.55
9	100 lbs. sulfur, 400 lbs. rock phosphate, dried blood	9.50	....	....	6.40
10	100 lbs. sulfur, 400 lbs. rock phosphate, dried blood	9.15	9.33	....	6.35
11	100 lbs. sulfur, 500 lbs. acid phosphate, dried blood	11.70	....	....	6.5
12	100 lbs. sulfur, 500 lbs. acid phosphate, dried blood	11.40	11.55	1.97	6.5
13	Check, sodium nitrate	14.40	....	....	6.5
14	Check, sodium nitrate	13.30	13.85	....	6.5
15	100 lbs. sulfur, sodium nitrate	13.60	....	....	6.7
16	100 lbs. sulfur, sodium nitrate	13.10	13.35	....	6.5
17	400 lbs. rock phosphate, sodium nitrate,	13.90	....	....	6.55
18	400 lbs. rock phosphate, sodium nitrate,	14.15	14.03	.18	6.75
19	500 lbs. acid phosphate, sodium nitrate,	16.40	....	....	6.7
20	500 lbs. acid phosphate, sodium nitrate,	16.00	16.20	2.35	6.7
21	100 lbs. sulfur, 400 lbs. rock phosphate, sodium nitrate	13.05	....	....	6.5
22	100 lbs. sulfur, 400 lbs. rock phosphate, sodium nitrate	13.85	13.45	....	6.5
23	100 lbs. sulfur, 500 lbs. acid phosphate, sodium nitrate	16.65	....	....	6.5
24	100 lbs. sulfur, 500 lbs. acid phosphate, sodium nitrate	15.80	16.23	2.38	6.4

There is a tendency for the plants to take up more phosphorus on the acid phosphate treated pots than on any of the others. The addition of sulfur along with the rock phosphate in the Elsinboro fine sand appears to increase the percentage of phosphorus in the plants over that with rock phosphate alone.

Another experiment was conducted with a different sample of Sassafras soil, which is tabulated in table 10. The results show a consistent increase in crop yield with acid phosphate, but none with the rock phosphate or rock phosphate-sulfur mixture.

The Influence of Sulfur on Plant Growth

Applications of sulfur have been found to enhance crop yields by various investigators in both this country and Europe. Certain calcareous soils in France have been found to respond to sulfur in a marked degree. The most outstanding results obtained in this country were those reported by the Oregon Experiment Station, in which large increases in the yield of alfalfa were obtained with small applications of sulfur.

The theory of the action of sulfur in soils has been a much discussed question. The various theories advanced may be summarized as follows:

First: A direct action on the plant, i. e., as a catalyst or stimulant in which the plant may not only take up sulfur in the form of sulfates or other sulfur compounds, but other so-called plant-food materials more readily as well.

Second: Action in modifying the bacterial flora of the soil similar to that of partial sterilization by heat, carbon bisulfide, etc.

Third: An indirect chemical action in which the sulfur is oxidized to sulfuric acid, thus withdrawing the oxygen of the soil-air and leaving the nitrogen free to be utilized by the nitrogen-fixing bacteria. The sulfuric acid formed might also act on inert minerals and render certain constituents available to plants.

In order to test the action of sulfur on crops grown in New Jersey soils, experiments were carried out in the greenhouse, using several of our local types of soil and several kinds of plants.

Three different samples of Sassafras loam soil and 2 of Penn loam were selected for the tests. The soils were air dried, and weighed into glazed earthenware pots. In experiments reported in tables 11 to 13 a general application of 5-8-5 fertilizer (one-half the nitrogen from nitrate of soda and one-half from dried blood) was made at the rate of 1,000 pounds per acre, to all pots except those in which soybeans were grown, in which case 0-8-5 fertilizer was used. When lime was used it was added in amounts equal to 2,000 pounds of limestone per acre. Where the effect of the nitrogenous fertilizers was to be studied (table 14), a 0-8-5 fertilizer was added to all pots, and nitrogen applied in the form of the material to be studied, in amount equal to that in a 5-8-5 fertilizer applied at the rate of 500 pounds per acre. The pots on which soybeans were grown received no nitrogen.

The results given in table 11 are the average of duplicate pots for each treatment, while in tables 13 and 14 the results are averages of 4 pots for each treatment.

In table 11 are recorded the results obtained on a very acid Sassafras soil, while tables 12 and 14 give results on the same type of soil, which are less acid. The results on the Penn loam soils are given in tables 13 and 14.

TABLE 11

The Stimulating Action of Sulfur on Plant Growth

SULFUR ADDITIONS per acre	Barley		Buckwheat	
	Average weight of crops	pH	Average weight of crops	pH
lbs.	*gm.*		*gm.*	
None	46.0	5.7	16.00	5.7
10	43.2	5.7	15.10	5.7
25	42.9	5.7	16.80	5.6
50	44.2	5.6	15.70	5.6
100	44.2	5.6	15.20	5.5
	Mustard		Soybeans	
None	16.40	5.8	13.80	5.8
10	16.90	5.7	12.20	5.7
25	12.20	5.7	14.00	5.7
50	10.70	5.6	13.90	5.7
100	6.80	5.5	14.50	5.5

The results recorded in table 11 show that the growth of barley, buckwheat and mustard are materially reduced by the application of sulfur, while soybeans are apparently not affected one way or the other. On the other hand, in the same type of soil taken from different localities, we find that sulfur has given increases in the yield of certain crops. The results recorded in table 12 show that the application of small amounts of sulfur has slightly increased the yield of barley, and has very materially increased the yield of a crop of radishes which were sown as soon as the barley was harvested. In the pots which had received the 100-pound application of sulfur the weight of the crop is more than double that from the check pots. Other experiments showed similar increased yields of radishes when sulfur was applied.

TABLE 12

Influence of Varying Amounts of Sulfur on the Growth of Barley and Radishes

SPECIAL TREATMENT (Calculated on acre basis)	Barley			Radishes (Residual crop)					Total weight both crops	
	Dry weight	Increase over check	pH value	pH value	Weight tops and roots	Increase over check	Weight of roots	Increase over check		Increase over check
	gm.	gm.			gm.	gm.	gm.	gm.	gm.	gm.
None	14.95	....	6.8	6.7	16.00	....	9.00	....	30.95	....
10 lbs. sulfur	15.65	.70	6.7	6.6	30.00	14.00	15.50	6.50	45.65	14.70
25 lbs. sulfur	15.55	.60	6.5	6.7	37.00	21.00	23.00	14.00	52.55	21.60
50 lbs. sulfur	17.50	2.55	6.6	6.5	29.00	13.00	16.80	7.80	46.50	15.55
100 lbs. sulfur	17.40	2.45	6.4	6.3	40.00	24.00	27.50	18.50	57.40	26.45
Lime	16.25	....	7.5	7.4	31.00	....	18.70	....	47.25	....
Lime, 10 lbs. sulfur	17.70	1.45	7.4	7.4	34.00	3.00	18.60	....	51.70	4.45
Lime, 25 lbs. sulfur	15.65	....	7.3	7.2	31.60	....	19.00	.30	46.65	....
Lime, 50 lbs. sulfur	16.80	.55	7.3	7.2	33.00	2.00	19.00	.30	49.80	2.55
Lime, 100 lbs. sulfur	17.05	1.40	7.0	6.9	28.50	....	19.50	.80	45.55	....

TABLE 13

Influence of Varying Amounts of Sulfur on the Growth of Soybeans and Radishes

SPECIAL TREATMENT (Calculated on acre basis)	Soybeans			Radishes (Residual crop)					Total weight both crops	
	Dry weight	Increase over check	pH value	Weight tops and roots	Increase over check	Weight of roots	Increase over check	pH value		Increase over check
	gm.	gm.		gm.	gm.	gm.	gm.		gm.	gm.
None	5.75	....	6.3	100.4	....	49.50	....	6.0	106.15	....
10 lbs. sulfur	5.60	....	6.1	96.5	....	42.80	....	6.0	102.10	....
25 lbs. sulfur	7.00	1.25	6.1	115.0	14.60	64.0	14.50	6.0	122.00	15.85
50 lbs. sulfur	6.00	.25	6.1	101.0	.60	49.5	....	6.0	107.00	0.85
100 lbs. sulfur	5.45	....	5.9	104.0	3.60	56.0	6.50	6.0	109.45	3.30
Lime	5.20	....	7.0	91.0	....	43.0	....	6.7	96.20	....
Lime, 10 lbs. sulfur	5.50	.30	7.0	123.0	22.60	61.5	12.00	6.7	128.50	22.35
Lime, 25 lbs. sulfur	5.00	....	7.0	89.0	....	52.0	2.50	6.7	94.00	....
Lime, 50 lbs. sulfur	3.65	....	6.9	113.0	12.60	54.5	5.00	6.5	116.65	10.50
Lime, 100 lbs. sulfur	5.20	....	6.8	98.6	....	49.0	....	6.4	103.80	7.65

Influence of Sulfur on Yield of Crops

SPECIAL TREATMENT (acre basis)	Millet			Rape			Soybeans*		
	Dry weight of crop		pH of soil	Dry weight of crop		pH of soil	Dry weight of crop		pH of soil
	Average	Increase over check		Average	Increase over check		Average	Increase over check	
	gm.	gm.		gm.	gm.		gm.	gm.	
Sassafras Loam									
Dried blood	15.25	....	6.1	17.17	....	6.13	12.57	....	6.1
10 lbs. sulfur, dried blood	13.25	....	6.0	21.57	4.40	6.23	18.78	6.21	6.2
25 lbs. sulfur, dried blood	15.20	....	6.08	17.47	0.30	6.03	17.28	4.71	6.1
50 lbs. sulfur, dried blood	15.30	....	5.9	24.27	7.10	6.10	15.07	2.50	6.0
$NaNO_3$	37.70	....	6.13	25.30	....	6.13	....	....	....
10 lbs. sulfur, $NaNO_3$	38.17	0.47	6.08	23.30	....	6.20	....	....	....
25 lbs. sulfur, $NaNO_3$	39.60	1.90	6.10	32.55	7.25	6.18	....	....	....
50 lbs. sulfur, $NaNO_3$	38.94	1.24	6.0	32.28	6.98	6.08	....	....	....
Penn Loam									
Dried blood	31.76	....	6.5	12.87	....	6.45	28.13	....	6.50
10 lbs. sulfur, dried blood	30.50	....	6.5	12.13	....	6.5	21.96	....	6.45
25 lbs. sulfur, dried blood	31.00	....	6.45	13.80	.93	6.45	28.73	.60	6.45
50 lbs. sulfur, dried blood	31.90	0.14	6.40	13.73	.86	6.45	28.60	.47	6.45
$NaNO_3$	45.80	....	6.5	24.27	....	6.5	....	....	....
10 lbs. sulfur, $NaNO_3$	44.37	....	6.45	24.46	.19	6.5	....	....	....
25 lbs. sulfur, $NaNO_3$	46.90	1.10	6.45	24.50	.23	6.45			

Good results were obtained with sulfur in another Sassafras soil. Table 14 shows that increases were obtained in the case of rape and soybeans. In the case of millet the increases were very small and insignificant.

An examination of the roots of the soybean plants showed larger nodules on the plants grown in the pots receiving 10 and 25-pound applications of sulfur.

No increase in crop from sulfur treatment was noted in the case of the soybeans on the Penn loam soil (tables 13 and 14), although the crop of radishes was very much enhanced by the application of sulfur at the rate of 10, 25 and 50 pounds per acre.

The Influence of Sulfur when Used in Combination with Manure

French investigators have found that the beneficial result obtained *on crop growth with sulfur was proportional to the soil organic* matter. Experiments reported by Chauzit, in which sulfur was intimately mixed with manure before applying to the soil, gave larger increases in crop yield than when the materials were applied separately.

In order to determine whether combinations of this kind would increase crop yields on a Sassafras soil, an experiment was carried on in the greenhouse. Two-gallon pots with 18 pounds of soil per pot were used. Manure was applied at the rate of 20 tons per acre, and the limed pots received limestone at the rate of 3,000 pounds per acre. The outline of the experiment and results obtained are given in table 15. The various treatments were in duplicate, and the results given in the table are the average weights of the crops from duplicate pots.

The first crop grown was radishes, followed by a residual crop of barley. In only one case was an increase in the crop of radishes obtained by intimately mixing the sulfur and manure, rather than applying them separately to the soil.

In this case an application of 100 pounds of sulfur and 20 tons of manure *intimately mixed before applying, where the soil was heavily* limed, has given 12.9 per cent more radishes than where the same application of materials was applied separately.

As in other experiments reported here, the crop of radishes on the pots receiving sulfur has been greatly increased.

TABLE 15

Influence on Plant Growth of Sulfur Mixed With Manure

SPECIAL TREATMENT (Calculated to acre basis)	Treatment No. 1 Manure and sulfur applied separately				Treatment No. 2 Manure and sulfur intimately mixed				Increase over treatment No. 1		
	Radishes		Barley (residual crop)	pH	Radishes		Barley (residual crop)	pH	Radishes		Barley
	Tops and roots	Roots			Tops and roots	Roots			Total	Roots	
	gm.	*gm.*	*gm.*		*gm.*	*gm.*	*gm.*		*gm.*	*gm.*	*gm.*
None	114.0	62.50	17.60	6.6	114.0	62.50	17.60	......	......	......	......
25 lbs. sulfur	132.0	76.00	15.30	6.75	110.8	54.15	17.65	6.65	—2.12	—21.85	2.35
50 lbs. sulfur	126.5	72.50	14.87	6.5	128.0	72.90	17.23	6.50	1.50	.40	2.36
100 lbs. sulfur	132.5	75.75	16.38	6.5	124.0	67.75	14.60	6.70	—8.50	—8.00	—1.78
Lime	102.0	50.15	19.80	7.0	102.0	50.15	19.80	......	......	......	......
Lime, 25 lbs. sulfur	104.4	57.25	20.43	7.3	92.50	51.40	23.78	7.80	—11.9	—5.85	3.35
Lime, 50 lbs. sulfur	131.5	72.25	18.68	7.35	110.10	60.50	17.53	7.90	—21.4	—11.75	—1.15
Lime, 100 lbs. sulfur	112.6	60.50	19.40	7.4	122.25	68.30	17.80	7.70	9.65	7.80	—1.60

Report of the Department of Plant Physiology

John W. Shive

Satisfactory progress has been made upon all the active projects in the department of plant physiology during the fiscal year ending June 30, 1924. Although no new projects have been inaugurated, the scope of the now active ones has been extended to include some new problems which naturally fall within the range of these projects.

During the year some outstanding results have been obtained. These relate in particular to the work on the iron project and the seed-weight project. It has been shown that a concentration of available iron in the culture medium slightly in excess of that required to maintain the plant in a normally healthy condition, may result, not only in iron toxicity, but also in a chlorotic condition of the leaves characteristic of a lack of iron in these organs. Quantitative analyses of plant tissues have shown that chlorotic plants, as well as those suffering from iron toxicity, exhibit a relatively very high iron content. In the chlorotic plants, however, the iron is precipitated in the roots and stems before entering the leaves. Normally healthy green plants show a relatively low iron content, but the iron is uniformly distributed throughout all portions of the plant, as indicated by quantitative analyses. There appears to be a very delicate balance within the plant with respect to this element, which requires that the available iron in the substratum in which the plant is rooted be limited to a very narrow range of concentrations. An unhealthy condition of the plant appears to render the iron immobile and the plant suffers in consequence.

Work on the seed-weight project has been directed mainly to the study of rates of growth of soybean plants from seeds of different weights, determined at brief intervals throughout the life cycle. These studies have brought out the fact that plants grown from small seeds have higher "efficiency indices" (calculated according to the compound interest law of Blackman from several types of plant measurements) than have plants grown from heavy seeds. This suggests that the great initial advantage gained by the plant grown from the large seed over that grown from the small seed, due to the larger supply of reserve food, is gradually lost during the growth cycle.

It is shown, however, that the efficiency indices of the plants grown from small seeds are not sufficiently higher than those of plants grown from large seeds to completely overcome the initial disadvantage of the former during the comparatively short life cycle of such plants as

beans, corn and radishes, with the result that the crop from the large seed is, in general, considerably greater than the corresponding crop from the small seed. The data thus far obtained strongly suggest that, other things being equal, any initial disadvanage to plants grown from small seeds of a given species may be completely wiped out during the extended life cycle of biennials and perennials, and that equivalent crops may be expected of plants grown under similar conditions from large and from small seeds of a given species. This is merely a suggestion, however, since there is not yet sufficient information at hand to substantiate such a conclusion.

Studies are now being made to determine the relative rates of the absorption of nitrogen in the form of the ammonium ion and the nitrate ion by plants at various stages of their development when grown in approximately optimal culture solutions containing these ions, both singly and in combination. Thus far, soybeans alone have been used as the indicator plants. The experiments carried out during the year have corroborated the results previously obtained, and have given some additional information. During the early stages of growth, the seedlings appear to absorb nitrogen from solution in the form of the ammonium ion much more rapidly than in the form of the nitrate ion when both these ions are present in the medium. During the later stage of growth, however, this relation appears to be reversed. Whether this reversal is a gradual process, or occurs at any definite stage in the life cycle, such as the flowering stage, has not yet been determined.

Under the project of salt requirements much of the work was directed toward perfecting a technique, begun last year, for the growth of alfalfa in solution cultures. This work has been attended with marked success, and, as a result, a study has been made of the salt requirements of the alfalfa plant. In connection with this work, quantitative determinations were made of the nitrogen content of the plants grown in culture solution in which all the salt constituents were varied according to a definite plan. It was found that the nitrogen content of the plants varied considerably, this variation being determined in a large measure by the relative proportions of the essential salt constituents of the media. The fact that the investigations show that the chlorine content of alfalfa from different parts of the country differs greatly, and that this may bear some relation to the preference in the market for alfalfa grown in certain regions; and, further, the purely scientific interest which still attaches to the question as to whether chlorine is an essential element for the growth of this plant, have suggested a study, begun last year, of the effect of sodium chloride upon the growth of alfalfa both in solution and in soil cultures. Considerable time has been devoted to these studies during the year and some notable results have been obtained. These will be dealt with in several manuscripts now in preparation.

During the year investigations have been carried out dealing with the influence upon the plant of omitting each one of the essential ions singly from otherwise balanced culture solutions, and studying the effect upon absorption by the plant of the remaining ions and upon the composition of the plants. These investigations have brought out some interesting and important facts in regard to the lack of one ion upon the absorption of another and its relation in determining the composition of the plant.

Manuscripts have been prepared dealing with the results of much of the investigational work that has been carried out during the year. Some of these have been published. Others are now in press, and some are still to be prepared.

Report of the Department of Entomology

Thomas J. Headlee, Ph.D.

INTRODUCTION

The department of entomology is concerned with the following projects: (1) Mosquito control, (2) climate and insect investigations, (3) orchard insect investigations, (4) investigations of dusts and of stickers, spreaders and diluents for spraying and dusting mixtures, (5) *small fruit insect investigations*, (6) *vegetable insect investigations*, (7) arthropods injurious to poultry production, (8) insects injurious to market milk, (9) investigation of cranberry problems, (10) investigations of the biology of sewage disposal, (11) greenhouse insect investigations, (12) soil-infesting insect investigations, (13) bee investigations. Certain phases of projects 1, 2, 3, 4, 6, 9, 10, 12 and 13 have been actively pursued, while the rest of the projects have been temporarily inactive.

The entomologist, in addition to exercising a general oversight of all operations, has given especial attention to climate and insect investigations, that portion of orchard insect investigations dealing with the codling moth, that portion of the investigation of dusts and of stickers, spreaders and diluents for spraying and dusting mixtures dealing with nicotine dust and stickers for arsenical dusts, and soil-infesting insect investigations. Miss Augusta Meske, assisted by Miss Helen Hannah and temporary employees, has conducted the clerical work of the office. Dr. Alvah Peterson has devoted his attention to the investigation of the pepper maggot, to the chemical attraction of the adults of the onion maggot and seed-corn maggot, and to the life history and habits of the oriental peach moth. Dr. Willem Rudolfs has devoted his attention to nicotine dusts and certain phases of the mosquito control investigations. Mr. Wilbur M. Walden has devoted his attention to practical mosquito control operations. Mr. Charles S. Beckwith has devoted his attention to cranberry problems. Mr. Carl Ilg has continued his work as assistant to the entomologist in his investigations and as assistant curator of the insect collections. Mr. Ray Hutson has continued his apicultural investigations. Mr. Elton S. Stinson closed up his work on the stickers for insecticidal dusts and has accepted a position with the National Packing Corporation of Ogden, Utah. Mr. Byrley F. Driggers has continued his investigation of certain phases of the cranberry problem. Mr. Walter E. Fleming has closed up his investigation of gases used as soil insecticides for Japanese beetle grubs and has accepted a position with the Japanese Beetle Laboratory. Mr. Louis A. Stearns became a member of the staff on April 1, 1924, and is now carrying out the investigation of field methods of controlling the oriental peach moth.

CORRESPONDENCE

Unfortunately, the limitation set upon the length of this report renders it necessary to omit our usual correspondence records—which, by the way, in addition to showing a form of our activities upon which considerable time and money is expended, form a body of data from which conclusions regarding injurious insect periodicity can be drawn —and simply to state that 707 inquiries concerning insects were received and answered during the year, that these inquiries pertained to 218 different species of injurious insects. All told, the volume of correspondence, relating to various phases of insect work, amounts to about 7,000 letters written and sent out. This takes no account of the mail sent out in connection with the work of the New Jersey Mosquito Extermination Association or the Joint Substation for the Investigation of the Biology of Sewage Disposal, which amounts to about 5,000 pieces.

INSECTS OF THE YEAR

For the purpose of pointing out the nature of the prevalence of economic insects in the state, the entomologist desires to mention specifically certain species.

The Codling Moth. The codling moth (*Carpocaspa pomonella*) has shown even greater abundance, especially in the Glassboro district, during the season which came to an end last fall, than at any time during the last decade. In other sections of the state it has not shown material increase over the conditions of the preceding year.

The Apple Tree Tent Caterpillar. The apple tree tent caterpillar (*Malacasoma americana*) has been more abundant throughout the state this year than at any time during the last decade. While its attention has been primarily taken up with wild cherry, it has done a very unusual amount of damage in uncared for orchards.

Canker Worms. Both fall (*Alsophila pometaria*) and spring canker worms (*Paleacrita vernata*) have continued their forest-defoliation habit in Morris County stripping more or less completely large areas of trees. As yet no satisfactory organization has been created to take care of this large and important problem. Methods of controlling these insects and of creating the necessary organization to do the work have been furnished to the communities which are suffering from the pest.

The Oriental Peach Moth. The oriental peach moth (*Laspeyresia molesta*) appeared in unusually large numbers during the latter part of the season last fall and did much harm by infesting high percentages of the fruit. So important was the action of this insect that the legislature made a special appropriation for the study of methods of control. An account of the work organized under this appropriation will be given in a special section of this report.

The Gipsy Moth. The gipsy moth (*Porthetria dispar*) seems to have receded rapidly again this year under the treatments carried out by the joint efforts (U. S. Department of Agriculture and New Jersey State Department of Agriculture) against it and, if adequate funds are provided, it looks as if it may very well be exterminated.

Orchard Plant Lice. Orchard plant lice have been fairly abundant this year and the damage done by them has been large in proportion to the numbers because the rosy aphis (*Aphis sorbi*) has been especially prominent. Thorough spraying with winter-strength commercial lime-sulfur and nicotine solution seems to have been followed by adequate control but any failure in thoroughness of applying this treatment seems to have been followed by serious infestation. The green apple aphis, following July 1, 1923, gave a considerable amount of trouble but from the opening of spring to June 30, 1924, it has been rather scarce. Oat aphis has not been prominent at all during the last fiscal year.

Vegetable Plant Lice. The pea aphis has been present and has done some damage but has not been so prominent as last year. Vegetable lice in general have been very abundant in the spring of 1924 and where active measures of control were not taken against them have done a good deal of harm.

Wire-Worms. Wire-worms (*Elateridæ*) have appeared in epidemic proportions and it is believed safe to say that they are much worse this year than in any year during the last decade. They are not limited to soils which, one and two years ago were in sod, but are found in market gardens that have been under constant cultivation for years. A special section will be devoted to work against these insects.

White Grubs. White grubs (*Lachnosterna* Sp.) and (*Cyclocephala* Sp.) were very abundant and troublesome following July 1, 1923. During the spring and early summer to June 30, 1924, they have been decidedly less noticeable, in fact, there have been very few complaints concerning them.

The Rose Bug. The rose chafer (*Macrodactylus subspinosus*) was troublesome in the season of 1923 and has appeared in limited numbers to June 30, 1924, but the outbreak does not seem to be anything like as serious as that which occurred in each of the last two years.

The Japanese Beetle. The Japanese beetle has spread at rather a more rapid rate during the year just closing than in previous years, and the area is becoming very large. The joint effort against it concerns the New Jersey State Department of Agriculture and the United States Department of Agriculture and full information on the subject will be found in the publications issued from these two sources.

INVESTIGATIONS

Mosquito Control

The mosquito project will be made the subject of a separate section at the end of this report, and need not be discussed at this point.

Climate and Insect Investigations

In the annual report for the year 1922-23 it was shown that the reason underlying the inability of the common bean weevil larva to enter beans which had been mixed with finely ground colloidal clay, lay in the fact that the larva was unable to grapple the bean with sufficient strength to drill through the seed-coat. The next natural step was to determine the optimum size of particle for the composition of dusts to prevent entry into beans by this larva. In this test we included the following materials: Milltown ball clay No. 9, Highland clay, Bond D clay, hydrated lime, land plaster and ground limestone known as dolomite. Table 1 gives the results.

for the control of curculio and blossom-end injury by codling moth are comparable, it seems fair to compare the side-worm treatments in each of the different years from the standpoint of the total lead arsenate applied to the tree during the season, and the amount of lead arsenate applied per tree per treatment. It is assumed, of course, that ths degree of infestation was the same in all 3 years—approximately 100 per cent of the unsprayed fruit.

TABLE 2

Results of Side-worm Treatments

YEAR	No. of applications	Lead arsenate per tree per season	Lead arsenate per tree per treatment blossom fall on	No. of apples on count trees	Blossom-end injury	Deep side injury	Shallow side injury	Combined deep and shallow
		lbs.	*lbs.*		*per cent*	*per cent*	*per cent*	*per cent*
1921	15	4.40	0.32	3105	0.0	1.9	19.3	21.4
1922	7	2.06	0.344	3961	0.0	3.6	5.8	9.4
1923	8	1.26	0.18	2719	1.7	17.3	48.0	65.3

The total average amount of powdered lead arsenate applied per season per tree is chiefly interesting because of the cost of material for treatment. It is the amount of powdered lead arsenate per tree per treatment that should be examined, because that phase of the matter indicates how much arsenic the codling moth larvæ will have to meet in entering the apple. Of course, the ideal standard must, eventually, be the amount of arsenic per square inch of leaf and fruit surface.

Leaving out of consideration the delayed dormant treatment in which no arsenical is used, and the pink bud in 1921, the trees, from the blossom fall on, received 0.32 pounds of powdered lead arsenate per treatment; in 1922 they received 0.344 pounds of powdered lead arsenate per tree per treatment, and in 1923 they received 0.18 pounds of powdered lead arsenate per tree per treatment. Corresponding to this we find that, in 1921, there was 21.4 per cent injury by side worms; in 1922, 9.4 per cent, and in 1923, 65.3 per cent. The comparison between the work of 1921 and 1922 is justified, because arsenical coating was maintained throughout the period of entry by side worms of the first and of the second broods of codling moth. The comparison of all 3 years is not entirely fair, because the coating was not maintained throughout these periods in 1923. Thus, it seems that there is a distinct correlation, when other factors are the same as they are believed to be in 1921 and 1922, between the amount of

TABLE 1

Effect of the Size of the Particle on the Effectiveness of Certain Dust Materials

Dilution in parts by weight		Milltown Ball Clay No. 9 No. of exit holes					Highland Clay No. of exit holes					Bond D Clay No. of exit holes				
Clay	* Beans	80 mesh	100 mesh	140 mesh	200 mesh	270 mesh	80 mesh	100 mesh	140 mesh	200 mesh	270 mesh	80 mesh	100 mesh	140 mesh	200 mesh	270 mesh
1	5	0	0	2	0	0	0	0	0	17	0	0	0	0	0	0
1	10	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0
1	20	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
1	30	0	0	0	0	0	1	14	0	0	0	0	9	0	0	0
1	50	0	0	0	15	0	9	23	1	0	0	3	7	6	0	35
1	60	0	0	0	0	0	153	64	0	2	0	24	9	0	0	3
1	70	0	0	0	0	0	21	50	9	0	0	2	57	10	2	0
1	80	0	0	0	0	0	9	5	47	0	4	0	12	0	0	0
1	90	0	0	0	0	0	1	0	14	0	1	12	44	25	4	16
1	100	0	0	0	0	0	39	0	0	0	6	0	53	0	16	0
1	500	5	0	0	0	12	1	43	1	0	1	23	6	26	1	1
Check		154	28	39	118	92	122	21	177	105	43	58	195	34	105	58

TABLE 1—Continued

Effect of the Size of the Particle on the Effectiveness of Certain Dust Materials

Dilution in parts by weight		Hydrated lime No. of exit holes					Land Plaster No. of exit holes					Dolomite No. of exit holes				
Clay	Beans	80 mesh	100 mesh	140 mesh	200 mesh	270 mesh	80 mesh	100 mesh	140 mesh	200 mesh	270 mesh	80 mesh	100 mesh	140 mesh	200 mesh	270 mesh
1	5	23	0	28	4	21	0	30	25	1	0	2	0	0	0	0
1	10	22	0	2	12	22	5	34	49	6	0	20	4	0	16	1
1	20	25	11	5	36	59	0	56	7	3	0	7	11	16	4	0
1	30	18	34	0	40	3	7	11	84	19	0	2	0	7	17	0
1	50	33	90	26	120	53	74	110	134	0	7	0	24	4	50	0
1	60	101	27	15	102	126	101	103	132	17	12	51	30	0	54	17
1	70	153	52	124	38	163	17	33	53	62	21	7	24	18	75	58
1	80	33	25	35	96	78	1	99	5	17	0	0	0	30	13	9
1	90	218	12	84	159	148	6	77	48	9	3	60	15	80	25	40
1	100	122	0	40	162	92	12	13	7	55	16	11	6	9	37	51
1	500	166	27	20	173	22	28	128	62	62	57	42	105	39	61	......
Check		172	80	160	235	67	56	160	241	105	66	133	120	147	77	123

*Each culture was seeded with 10 adults of the common bean weevil and was kept during the summer at room temperature, changing to the constant of 80° F. when the necessity f or artificial heat in the building arrived. The beans were the common white variety. An exit hole represents a new adult.

Table 1 serves to show that of the six dusts experimented with, Milltown ball clay No. 9 is, without doubt, the most efficient, and that 100-mesh material is apparently composed of the best size particle.

Orchard Insect Investigations

Codling Moth

In the annual report for the year 1922-23 the entomologist offered a discussion of the three main factors in codling-moth control by spray applications as it appears in New Jersey. All three sprays (blossom fall, first brood side worm and second brood side worm) are shown to be important, but the results in their practical use in New Jersey are such as to demand far more emphasis upon the second and third than upon the first.

The point was made that where codling moths were abundant (enough to infest practically 100 per cent of all the apples borne by the unsprayed trees) during the periods covered by the entry of the side worms of the first and second broods, a film coating (charged with arsenicals) of fruit and foliage must be maintained if satisfactory control is to be obtained. The point was also made that this film coating can be maintained, under normal weather conditions, almost or quite without accessory spraying, if an adequate spreader and sticker is incorporated in the spray mixture. It was also pointed out that the cost of this operation is sufficiently small to justify its employment, where codling moth conditions demand drastic measures of control.

To these general conclusions the entomologist wishes to add an analysis of the factors which he thinks underlie the efficient employment of the first brood side worm and the second brood side worm sprays for codling moth. Assuming that the sprays were properly timed and that the infestation is equally dense, these factors are believed to be the amount of arsenical per tree and the continuity with which the arsenical coating is maintained. In 1921 an earnest effort was made to maintain a coating of spray materials, incorporating from blossom-fall on, 2 pounds of powdered lead arsenate in each 50 gallons of spray mixture, on both fruit and foliage throughout the periods covered by the entry of the first brood side worms and the second brood side worms. In the following year another attempt was made to maintain this coating, utilizing, in this instance, a charge of 2 pounds of powdered arsenate of lead to 50 gallons of spray material. In 1923 a schedule of treatments was followed and less attention was paid to the maintenance of the coating. The results of the best treatments made with combinations of elemental sulfur, hydrated lime and powdered lead arsenate are recorded in table 2. It must be recognized that the number of treatments outlined in the following table include all treatments. As a matter of fact, in the year 1921 the number of treatments for side worms was 10, in 1922 the number was 2, and in 1923 the number was 3. Inasmuch as the application of arsenicals

for the control of curculio and blossom-end injury by codling moth are comparable, it seems fair to compare the side-worm treatments in each of the different years from the standpoint of the total lead arsenate applied to the tree during the season, and the amount of lead arsenate applied per tree per treatment. It is assumed, of course, that ths degree of infestation was the same in all 3 years—approximately 100 per cent of the unsprayed fruit.

TABLE 2

Results of Side-worm Treatments

YEAR	No. of applications	Lead arsenate per tree per season	Lead arsenate per tree per treatment blossom fall on	No. of apples on count trees	Blossom-end injury	Deep side injury	Shallow side injury	Combined deep and shallow
		lbs.	*lbs.*		*per cent*	*per cent*	*per cent*	*per cent*
1921	15	4.40	0.32	3105	0.0	1.9	19.3	21.4
1922	7	2.06	0.344	3961	0.0	3.6	5.8	9.4
1923	8	1.26	0.18	2719	1.7	17.3	48.0	65.3

The total average amount of powdered lead arsenate applied per season per tree is chiefly interesting because of the cost of material for treatment. It is the amount of powdered lead arsenate per tree per treatment that should be examined, because that phase of the matter indicates how much arsenic the codling moth larvæ will have to meet in entering the apple. Of course, the ideal standard must, eventually, be the amount of arsenic per square inch of leaf and fruit surface.

Leaving out of consideration the delayed dormant treatment in which no arsenical is used, and the pink bud in 1921, the trees, from the blossom fall on, received 0.32 pounds of powdered lead arsenate per treatment; in 1922 they received 0.344 pounds of powdered lead arsenate per tree per treatment, and in 1923 they received 0.18 pounds of powdered lead arsenate per tree per treatment. Corresponding to this we find that, in 1921, there was 21.4 per cent injury by side worms; in 1922, 9.4 per cent, and in 1923, 65.3 per cent. The comparison between the work of 1921 and 1922 is justified, because arsenical coating was maintained throughout the period of entry by side worms of the first and of the second broods of codling moth. The comparison of all 3 years is not entirely fair, because the coating was not maintained throughout these periods in 1923. Thus, it seems that there is a distinct correlation, when other factors are the same as they are believed to be in 1921 and 1922, between the amount of

arsenical which the side worm would have to meet in order to enter the fruit and the percentage of side worm injury which actually occurs. In general, it may be said that the side worm injury varies inversely as the amount of arsenical which the side worms have to meet in entering the fruit.

From the standpoint of coat maintenance, it is interesting to compare blocks 1 and 2 of the experiments in 1921[1]. In block 1 the 7 regular treatments were applied, including the delayed dormant, and in block 2 the 7 regular treatments were applied and 8 accessory applications were made. In block 1 there were considerable periods of time in which there was no appreciable amount of arsenical upon fruit and foliage, and, without any doubt, some of these periods coincided, partly, at least, with the period of entry of side worms of the first and second broods. Block 1 showed 37.6 per cent of the fruit injured by side worms of codling moth, and block 2 showed 21.4 per cent injured.

It is further enlightening to compare the record of block 4 in 1921 with the record of similar spray materials in 1923. Block 4 received the schedule spray, but in much lighter applications than block 1. The impression of the entomologist is that block 4 in 1921 received much the same sort of treatment that was given the blocks in 1923. The codling moth side worm injury in block 4 in 1921 was 68.8 per cent, while the side worm injury in 1923 was 65.3 per cent. The difference in the amount of arsenic applied between the per-tree-per-treatment application in blocks 1 and 2 in 1921 was nil, while the real difference lay in the continuity of the coating. The coating was not continuous in block 1 and was continuous in block 2, the result being 13.2 per cent more injury by side worm in block 1 than in block 2. It seems, therefore, that the factor of continuity in coating, during the period when the side worms of the codling moth of the first and second broods are entering, is the important factor, and that the injury varies inversely as the continuity of the coating.

When all these facts are taken into consideration, it seems reasonable to conclude that control of codling moth depends very largely upon the amount of arsenical which the side worms must meet in making their way into the fruit, and that both the amount of arsenical applied to the tree at any one treatment during this period, and the amount that is maintained there, are exceedingly important.

The results of the treatment for codling moth and curculio at Glassboro in 1923, given in table 3, have not hitherto been recorded.

In the annual report for spray burn on apple for the year 1922-23, under discussion of types, materials and methods of application, it was pointed out that a combination of elemental sulfur, hydrated lime and powdered lead arsenate gave us a mixture which came as near, from the standpoint of efficiency and freedom from injury, to being a sat-

[1]Headlee, T. J. 1924. Report of the Department of Entomology. *In* N. J. Agr. Exp. Sta. 1923 Ann Rpt., p. 271.

TABLE 3

Results of Treatment for Codling Moth and Curculio—Glassboro, 1923

BLOCK NO.	Number of trees counted	Treatment	Total fruit	Sound	Curculio	Codling Moth: Blossom end	Codling Moth: Deep side	Codling Moth: Shallow side	Aphis	Spray injury
				per cent	per cent	per cent	per cent	per cent	per cent	per cent
Check....	3	None	4841	8.0	2.8	25.1	57.9	50.4	0.2	0.0
I....	4	A	3267	18.7	1.9	6.2	30.0	75.2	0.2	0.0
II....	4	B	6993	31.7	1.6	2.6	23.2	54.2	0.65	0.0
III....	4	C	4859	37.2	0.6	2.5	13.0	52.0	.....	1.6
IV....	4	D	2422	35.4	2.8	3.8	9.8	59.9	.....	5.3
V....	4	E	2719	33.5	0.6	1.7	17.3	48.0	.....	3.6
VI....	4	F	3012	25.3	0.8	2.6	39.5	49.2	.....	3.08
VII....	4	G	3785	44.5	0.2	0.6	19.3	42.2	.....	5.15
VIII....	4	H	2992	36.9	0.1	0.3	26.2	51.5	.....	4.44

Treatment notes:

1. Concentrated lime-sulfur (1-9) + 40 per cent nicotine (1-500) applied to all blocks as delayed dormant spray.
2. Concentrated lime-sulfur (1-40) + powdered lead arsenate (1.5 lbs.-50 gal.) applied to all except block 3 at pink bud.
3. A. Standard dry-mix + powdered lead arsenate (1.5 lbs.-50 gal.) applied as per spray schedule including a second application for second brood codling moth. Application made with rods and nozzles.
   B. Same as "A" except that material was applied pilot rod and spray gun.
   C. Same as "B" except that treatment started with pink bud.
   D. Same as "B" except that dry-mix was prepared with 1 lb. of Kayso to 200 gal.
   E. Same as "B" except that dry-mix was prepared with 3 lbs. of Kayso to 200 gal.
   F. Same as "B" except that dry-mix was prepared with superfine dusting sulfur.
   G. Same as "B" except that concentrated lime-sulfur (1-40 + 2 lbs.) of Kayso to 200 gal. was used.
   H. Same as "G" except that no Kayso was used.
4. Average of 6 gal. per tree per application was used.
5. Eight applications were made on the following dates:

Delayed dormant	April 6, 1923
Pink bud	April 24, 1923
Petal fall	May 10, 1923
Seven-day spray	May 17, 1923
Seventeen-day spray	May 28, 1923
First brood codling moth side worm spray	June 13, 1923
Second brood codling moth side worm spray	July 9, 1923
Second brood codling moth side worm spray	July 24, 1923

isfactory substitute for self-boiled lime-sulfur and lead arsenate as anything that had hitherto developed. This mixture, as was pointed out, had been named the "New Jersey Dry-Mix." There has always been a question in the minds of the New Jersey station workers as to whether elemental sulfur would prove a satisfactory controlling agent for the fungous diseases to which the foliage and fruit of apple are subject, and for two or three years there has been a question in the mind of the entomologist as to whether a combination of elemental sulfur, hydrated lime and arsenate of lead would not, under certain favoring conditions, result in considerable burning to the fruit and foliage of apple. In fact, he has seen, from time to time, burning upon fruit and foliage of apple in this state that seemed to him to be chargeable to the application of this mechanical mixture of elemental sulfur, hydrated lime and lead arsenate.

	Mixtures	Soluble As_2O_3 *mgm.*
1.	374 cc. H_2O 1.35 gm. lead arsenate No CO_2	6.2
2.	374 cc. H_2O 1.35 gm. lead arsenate CO_2 passed through	6.2
3.	374 cc. H_2O 1.35 gm. lead arsenate 4.5 gm. H & H—SQUARE BRAND—COLLOIDAL SULFUR CO_2 passed through	6.2
4.	374 cc. H_2O 1.35 gm. lead arsenate 4.5 gm. H & H—SQUARE BRAND—COLLOIDAL SULFUR .11 gm. lime CO_2 passed through	13.70
5.	374 cc. H_2O 1.35 gm. lead arsenate 4.5 gm. H & H—SQUARE BRAND—COLLOIDAL SULFUR .22 gm. lime CO_2 passed through	14.65
6.	374 cc. H_2O 1.35 gm. lead arsenate 4.5 gm. H & H—SQUARE BRAND—COLLOIDAL SULFUR .45 gm. lime CO_2 passed through	14.83
7.	374 cc. H_2O 1.35 gm. lead arsenate 4.5 gm. H & H—SQUARE BRAND—COLLOIDAL SULFUR .56 gm. lime CO_2 passed through	15.21
8.	374 cc. H_2O 1.35 gm. lead arsenate .56 gm. lime	11.80

In the spring of 1924 there came on the common market, for the first time, what appears to be a true colloidal sulfur. A chemical study of suspensions of this colloidal sulfur and lead arsenate, and colloidal sulfur, lead arsenate and hydrated lime, revealed the curious fact that the first combination resulted in no increase in the amount

of water-soluble arsenic which was originally characteristic of lead arsenate itself, while the second of these mixtures resulted in a decided increase of the water-soluble arsenic which was characteristic of the lead arsenate itself. Although the writer has had no chance to take accurate data upon either the fungicidal value of this colloidal sulfur or the burning of fruit and foliage by the combination of colloidal sulfur and lead arsenate, certain New Jersey growers, who have used this material on an experimental scale, stoutly maintain that it does control apple scab more efficiently than Dry-Mix, and does not exhibit any burning of fruit or foliage whatsoever. In all of these cases the material used consisted only of colloidal sulfur and arsenate of lead. Lime was in no case included. This product, and the experience with it up to date, seems to indicate that it may form a new and more satisfactory spray for apple than any which has hitherto been developed.

Bearing upon the matter in the preceding paragraph are some facts derived by Mr. Byrley F. Driggers, a graduate assistant in the department of entomology. In the course of his work, Mr. Driggers determined, apparently beyond question, that organic colloidal material, particularly such of this material as occurs in cranberry bog soil and water, is able to remove water-soluble arsenic from solution *and to render the same insoluble. It is not beyond reason to theorize* that an inorganic colloid, such as the above colloidal sulfur, might be capable of doing the same thing, and consequently might, when mixed with lead hydrogen arsenate, actually reduce the amount of water-soluble arsenic in the original product.

Most workers in entomology have an opportunity to observe what is called "spray burn" on foliage and on fruit of apples. There is one kind of spray burn apparently characteristic of bordeaux arsenical combinations, another characteristic of lime-sulfur arsenical combinations and another of very similar character, apparently characteristic of combinations of elemental sulfur, hydrated lime and arsenical. Most workers have also had a chance to observe arsenical spray burn, as such, when the arsenical is used by itself. Some workers have had a chance to observe spray burn where combinations of lead arsenate and lime have been used. There is still a question as to the source of these spray burns. Is it the arsenic which does the plant tissue killing, is it a new arsenical combination with a fungicide that is responsible, or is it the fungicide which does the work? It is thought that the general opinion would be that the arsenic is concerned primarily, one would suppose, because of the well-known ability of arsenic to cause spray injury.

Most workers in entomology have been accustomed to recommend the use of lime hydrate with lead hydrogen arsenate for the purpose of preventing spray injury. Some workers have, however, had opportunity to observe serious spray injury, resulting from this combination.

Mr. F. Leslie Campbell, a graduate student of the department of entomology, gave some careful attention to the relation which exists

between lead hydrogen arsenate and lime, when the mixture is applied to foliage. Mr. Campbell records his conclusions as follows: (1) Acid lead arsenate reacts slowly with calcium hydroxide to form tri-lead arsenate and tri-calcium arsenate and water; (2) arsenical injury to foliage by acid lead arsenate sprays and by acid lead arsenate and lime sprays seems to be made possible by the action of a leaf-water film on the dried spray deposit. The leaf-water film appears when temperature and relative humidity are high enough; (3) arsenic in the leaf-water film in the form of calcium arsenate is less injurious to foliage than it is in the form of arsenic acid—hence, a combination spray of lime and acid lead arsenate, which throws a trace of calcium arsenate into solution, would be expected to be safer for use than an acid lead arsenate spray alone, which throws a trace of arsenic acid into solution; (4) but concentration of the AsO_4 ion may become high enough in the leaf-water film in the combination spray deposit to cause serious injury, if the excess calcium hydroxide is completely converted to calcium carbonate and humid weather conditions prevail.

The above facts, relative to combinations of spray materials, indicate, at least, that under certain climatic conditions there exists an element of danger in the combination of sulfur, lime and lead arsenate sprays, but they also indicate that possibly this danger may be escaped through discarding the lime and employing a combination of an organic or possibly inorganic colloid with lead arsenate.

Oriental Peach Moth

The oriental peach moth has now reached the point where it is present in all the large peach-growing sections of the state. In some of them, notably in Burlington, Camden, Gloucester, Cumberland and Atlantic Counties, it infested the fruit seriously last year. In the first section infested, the Middletown section of Monmouth County, it exhibited serious injury a number of years ago, and since that time has shown the up and down movement by which it has been characterized in other peach-growing sections of the United States, where it has been present for a period of years. The work against the oriental peach moth up to and including the summer season of 1923 has been carried on by Dr. Peterson. The Legislature, meeting during the early part of 1924, responding to the urge of the fruit growers of the state, made an appropriation of $8,500 ($3.500 immediately available and $5,000 becoming available July 1, 1924) for the purpose of investigating this insect and finding measures of control.

The interest in this insect was sufficient to make the entomologist feel that the utmost attention should be given to the problem. Dr. Peterson has taken up the problem of the bionomics of the insect, Mr. Louis A. Stearns the field-testing and control side, and Dr. Rudolfs and the entomologist the insecticidal phases. Naturally, this work could merely be got under way previous to June 30, 1924, and there is comparatively little to report from that date.

The work against the oriental peach moth in the season of 1923 is given by Dr. Peterson.

Oriental Peach Moth in the Season of 1923

ALVAH PETERSON, PH.D.

During the past season the oriental peach moth, *Laspeyresia molesta* Busch, proved to be a serious pest in most peach-growing districts in New Jersey. In a large number of orchards it made its first appearance this season so far as known. In some instances the infestation in the newly-infested orchards ran as high as 90 per cent wormy fruit. The fruit of early and late varieties was subject to attack. There was some variation in this respect in different orchards. The author believes the early varieties suffered this past season because of the drought during the early part of the summer. The drought caused the shoots to stop growing. The larvæ of the second and following broods apparently abandoned the twigs and went into the fruit.

The author devoted a portion of his research time to an investigation of control measures for the oriental peach moth during the summer of 1923. The investigation was along two lines, a study of food habits of the adult and the use of nicotine sulfate as an ovicide.

As far as feeding habits are concerned, a number of odor-producing materials were placed in shallow glass dishes with sweetened media, molasses or corn syrup, at the rate of 5 drops to 5 cc. of sweetened media and 10 cc. of water. These dishes were placed in wire fly traps in the center of peach trees and in open dishes on inverted peach carriers under young peach trees. The odor-producing materials tried were: Amyl acetate, amyl alcohol, methyl alcohol, isopropyl alcohol, butylic alcohol, ethyl alcohol, allyl alcohol, aldehyde, benzaldehyde, etc. Several oils were tried—oil of peach kernels, rose geranium, spearmint, cinnamon, mustard (artificial), lemon, anise seed, nutmeg, peppermint and wintergreen.

In no case, so far as known, did an adult come to any of the traps or to the exposed dishes. These experiments were conducted twice during the summer, when the adults were flying.

Further tests were made with molasses or corn syrup diluted with water (1/3) plus yeast (wet compressed yeast, "Fleischman's yeast" or dry yeast, "Yeast Foam" and "Magic Yeast"), about 1 ounce per 3 quarts of bait. The baits were placed in round enamel pans (8 inches in diameter and 2 inches deep). The pans were placed on inverted peach carriers under peach trees or in the crotches of peach trees. During the period, when the adults were flying, a goodly number of males and females came to the pans, fell into the mixture and were unable to get out. They usually floated on top for 24 to 48 hours. Numerous other insects also came to the baits, particularly bees, wasps, hornets, flies and noctuid moths. It was necessary to clean out and refill the pans every few days (7-10 days). Probably a wire screen of the proper mesh placed over the pans might keep out the larger adult insects.

Ten of these pans were kept in the orchard from August 15 to October 1. During this period over 200 adults were captured. The maximum catch for 24 hours was 21, on August 10. The last adults were caught on September 27. For the entire period the males and females were approximately equal in number. As to whether the females were gravid or no was not determined.

An attractive bait for adults appears to be a satisfactory method of determining the period when the adults are plentiful in the orchard. It is probable that a better bait and a more satisfactory method of trapping adults may be found upon further investigation. It is probable that baits or traps for the adults may never prove to be a practical means of control.

Table 4 shows the results obtained from applying nicotine sulfate sprays (and dusts 7a) a few weeks previous to ripening of the peaches. These sprays were supposed to kill the eggs of the oriental peach moth larvæ which enter the ripening fruit.

Nicotine Sulfate

Mr. Louis A. Sterns, of the crop-pest commission in Virginia, apparently has obtained satisfactory control of the oriental peach moth in Virginia for several years by using nicotine sulfate syrup to kill the eggs. Four to five applications were made each season at the rate of 1 part of 40 per cent nicotine sulfate to 800 parts of spray. In Virginia the nicotine sulfate was added to the regular spray schedule, and, when additional sprays were necessary, soap was added to the nicotine.

On the basis of the above information the author had the opinion, at the outset of 1923, that nicotine sprays might be used to kill the eggs of the larvæ which enter the fruit and ignore those larvæ of the first brood which enter the twigs. So far as observed, the larvæ enter the fruit of late varieties some time after the first of August and later in the average season. The varieties selected for experiments were Elbertas, Hale, Fox Seedling, Iron Mountain and Krummel's October.

In an 8-year old orchard at Minetola, Hale, Fox Seedling, Iron Mountain and Krummel's October were located in one block with 3 to 5 rows of each variety. A spray block was selected which ran across these 4 varieties. The spray used was 40 per cent nicotine sulfate at the rate of ¾ pint to 50 gallons of water plus 2 pounds of soap to 50 gallons of water. Each tree received 1½ to 2 gallons of spray. The spray was applied with a gun and about 200 pounds pressure. So far as possible, the under sides of the leaves were coated. Fifteen to thirty trees of each variety were sprayed and the fruit (drops and picked fruit) was observed, and, in some varieties, cut open from 3 trees of each variety. The fruit from a similar number of check trees of each variety adjacent to the sprayed blocks were carefully examined. In selecting the count trees care was used to pick trees having a similar amount of fruit and within the center of the block (sprayed trees).

TABLE 4

Results of Nicotine Sulfate Spray Applications

Experiment	Location	Variety	Dates of Spray	Date of pick	Sprayed Fruit infested	Check Fruit infested	Reduction
					per cent	*per cent*	
1	Minetola	Hale	8/11, 8/18, 8/25	8/29	37	27.0	none
2	Minetola	Fox Seedling	8/11, 8/18, 8/25	9/12	36	29.0	none
3	Minetola	Iron Mountain	8/11, 8/18, 8/25	9/21	16	11.0	none
4	Minetola	Krummel's October	8/11, 8/18, 8/25	10/1	65	81.0	slight
5	Vineland	Iron Mountain	8/24	9/21	46	62.0	slight
5a	Vineland	Iron Mountain	8/17, 8/24	9/21	38	62.0	considerable
6	Vineland	Krummel's October	8/24	9/28	44	50.0	slight
6a	Vineland	Krummel's October	8/17, 8/24	9/28	40	50.0	slight
7	New Brunswick	Elberta	5/13, 8/20, 8/27, 9/5	9/7	20.6	25.3	slight
	New Brunswick	Elberta	Dusted 8/14, 8/21, 8/27	9/7	25.8	25.3	none

Table 1, experiments 1-4 shows the results obtained in this orchard. There was no material or consistent reduction in the infestation.

At Vineland, N. J., a block of 9-year-old Iron Mountain and Krummel's October was selected for a spray test with nicotine. One block of 60 trees, comprising the 2 varieties named, received one spray on August 24, and a similar adjacent block received two sprays on August 17 and August 24, respectively. The spray was nicotine sulfate (Black Leaf 40) ¾ pint to 50 gallons of water plus 1½ pounds of white naphtha soap. The spray was applied with a gun and under 200 pounds pressure. Three trees of each variety in each block, checks included, were selected for observation. The fruit was carefully observed from the outside only. Table 1, experiments 5, 5a, 6 and 6a, show in all cases slight to considerable reduction in the infestation in the sprayed blocks. This is the only series of tests which indicated that nicotine was affecting the infestation to any extent.

At the Wolpert Farm, New Brunswick, N. J., on August 13, 20, 27 and September 5, 6 trees of Elbertas laden with fruit were selected and thoroughly drenched with nicotine sulfate (Black Leaf 40) at the rate of ¾ pint to 50 gallons of water plus 2 pounds of naphtha soap. A similar lot of Elberta trees were thoroughly dusted on August 14, 21 and 27, with a ½ per cent nicotine sulfate dolomite-lime dust. Table 1, experiments 7 and 7a show little or no reduction in the visible infestation. The peaches from these trees also were cut open. After cutting open the peaches from each of the 3 blocks (sprayed, dusted and check), which appeared to be normal and showed no larval entrance on the surface of fruit or at the stem or blossom end, it was observed that 7 per cent of the apparently clean sprayed fruit possessed worms within, 19 per cent of the apparently clean, dusted peaches were wormy, and 13 per cent of the apparently clean check fruit were infested.

This observation is significant, for it shows the importance of cutting open the fruit, which appears to be normal from the outside, if one expects to ascertain the true amount of the infestation. All indications seemed to point to the fact that the larvæ of the infested fruit, which showed no larval entrance holes, apparently gained their entrance into the peach by eating through the green stem. When the fruit is picked or drops, the green stem is usually pulled out of the fruit and the point of entrance is destroyed.

Summary

So far as control measures are concerned no satisfactory method was discovered during the summer of 1923. All indications point to the fact that one cannot control this pest by using nicotine to kill the eggs of the larvæ of the second to fourth broods, which enter the fruit. Possibly more frequent sprays or dusts might bring about a more decided reduction when the infestations are heavy, yet too many applications of sprays or dusts will make peach production unprofitable.

The discovery that adults will come to sweetened yeast baits may prove to be a satisfactory method of determining the periods when the females are depositing eggs.

Investigation of Dusts and of Stickers, Spreaders and Diluents for Spraying and Dusting Mixtures

Dusts

The work on nicotine dust has been drawn to a close and the results have been published in Bulletin 381 and Bulletin 400.

Stickers for Sprays

No additional experimental work has been carried on during the present year on stickers to be included in water-carried spray materials. In practice the powdered skimmed milk has been used with great apparent success by at least two growers in the Glassboro district as a substitute for Kayso. The cost of this material has been only a little over one-third that of Kayso, and the amount used has corresponded pound for pound with Kayso.

Sticker for Dust Materials

In the beginning of the season of 1924 field tests of the most promising sticker developed up to date were instituted in an orchard at Glassboro, N. J. The results of this investigation will have to be given in the succeeding report or in a publication which may be issued previous to the next annual report. Suffice it to say that when the orchard dusts, in which the sticker has been incorporated, are put upon dew-covered foliage, a very decided sticking effect is observed, and the coating obtained is such as to lead experienced orchardists to mistake it for a spray.

Vegetable Insect Investigations

In this project Dr. Peterson was able to give some further attention to the pepper maggot and to carry out some studies of the chemotoxy of the onion maggot and seed-corn maggot adults. His account of this work follows.

Further Observations on the Pepper Maggot (Spilographa Electa Say) During 1923

ALVAH PETERSON, PH.D.

Introduction

The pepper maggot (*Spilographa electa* Say) again, in 1923, proved to be a serious pest of some varieties of peppers, particularly in Middlesex and Monmouth Counties. The peppers most seriously infested

were the round varieties, squash (tomato or cheese) and cherry peppers. During August and early in September the infestation in three separate fields averaged 75 to 90 per cent. At New Brunswick, where an infestation had not been seen before, the injured fruit averaged 50 to 60 per cent. No injury to eggplants was seen during 1923.

Notes on Life History and Habits

Several hundred puparia of *Spilographa electa* Say were kept in soil in flower pots out-of-doors in a wire-screen insectary during the winter of 1922-1923. Adults emerged from these pots between July 13 and August 3. The peak of emergence, under laboratory conditions, occurred late in July. All told, about 80 per cent of the pupæ produced adults. Approximately two-thirds of the adults were males. This was also true of field collections during 1923. Approximately two males were taken to each female. In the field the first adults were seen on June 27, while in 1922 the first adults were found on July 8. The last flies in 1923 were seen in the field August 20. A careful examination was made on September 4 and none were found. The maximum number of flies was captured in the field late in July and early in August.

To date but one generation per season has been noted for *Spilographa electa* Say in New Jersey.

Under field conditions the adult females punctured many small peppers, but deposited eggs in only a small proportion of the holes. On August 13 in one field 125 small squash peppers (½ inch to 1 inch in diameter) were collected. There were 403 egg punctures in 107 of the peppers, an average of 3.8 per pepper. All told, 62 eggs were found in the 403 egg punctures and located in 48 peppers. In other words, about 15 per cent of the egg punctures possessed eggs. The eggs were distributed as follows in the peppers: Forty peppers had 1 egg each, 5 had 2 eggs, 2 had 4 eggs and 1 had 5 eggs. An examination of the peppers late in July showed a somewhat greater percentage of peppers possessing eggs. Most of the adults emerging from the flower pots at the laboratory were placed in small 2-ounce bottles and covered with cheese cloth. A small feeding cup, containing cane sugar and water, was placed in each bottle. The bottles were placed in the shade on a window sill and the window was open almost all summer. A fresh supply of sweetened water was supplied when needed. To our surprise most of the adults lived for a long time under these conditions. The longest period was for a male and female which emerged on June 27. The early emergence of these individuals was due to the fact that the puparia were brought into the laboratory about May 15. The male and female continued to live in the small bottle until September 6 and 7, respectively, a period of 71 and 72 days. Many of the flies (males and females), which emerged out-of-doors at the laboratory, lived in the small bottles for 30 to 40 days.

This longevity was unexpected, for during the summer of 1922 and also during the past summer, adults captured in the field and placed in similar container never lived over three to five days. Most of them died in one or two days. Why there should be such a difference in longevity between reared and captured individuals, the author is unable to answer. This rapid mortality of captured adults played havoc with the spraying experiments for control.

Control Experiments

During 1923 two types of control experiments were tried, baits and arsenical sprays.

Baits

The following series of chemicals were employed to attract the adults: Allyl alcohol, methyl alcohol, ethyl alcohol, lipropyl alcohol, butylic alcohol, amyl alcohol, linolyl acetate, valeriamic acid, lactic acid, butyric acid, oleoresin capsicum, allyl sulfide, allyl iodide, acetic acid, aldehyde, formic acid, acetone ammonia, compressed yeast (Fleischman's) and dry yeast (Yeast Foam). The following oils were also tried: Spruce oil, fusel, Manhattan, orange, peach, rose geranium, camphor, hemlock, cinnamon, cedar, spearmint, peppermint, pineneedle, clove, mustard (artificial), anise seed, nutmeg, sassafras, etc. They were added to several media: brown sugar, cane sugar, honey, corn syrup or molasses plus water, but particularly to diluted corn syrup or molasses, at the rate of 5 drops to each teaspoonful of sweetened material, which was diluted with 4 or 5 teaspoonfuls of water. These baits were placed in Syracuse watch glasses under small wire fly traps similar to those employed, and which proved to be so successful in our experimental work on the attractive baits for the onion maggot and seed-corn maggot. The cages were placed on the ground and on inverted ⅝-bushel peach carriers between the rows of peppers, and approximately 50 feet apart. The experiments were conducted in a field where a serious infestation occurred in 1922. There were a goodly number of adults present on the pepper plants in the same field during July and early in August. The results were negative: only two adults were captured in the traps during the entire summer. Either the adults did not come to any of the baits or else the cages did not trap the adults. The author believes the former condition to be the truth.

Arsenate of Lead

At New Brunswick some 700 plants of squash peppers were planted at the Wolpert farm for experimental purposes. These plants were used primarily for spraying experiments with lead arsenate. The following experiments were conducted: Some of the plants were thoroughly sprayed with arsenate of lead at the rate of 1 ounce of

arsenate of lead, ½ ounce of calcium caseinate and 2½ gallons of water and others with the same mixture with no calcium caseinate. Wire screen cages made of 14-mesh wire and a trifle larger than the full-grown plant were placed over 10 of the sprayed plants and unsprayed plants. Adults (males and females) were captured in the field some 20 miles from New Brunswick, and immediately inserted into the cages. Five to 25 adults were placed in each cage at different periods during the summer. In all cases the captured adults died within 48 hours in the cages about the check and sprayed plants. In one experiment adults reared at the laboratory were used, and these lived for a week or longer in a check cage, while in the cages about a sprayed plant the adults died within 48 hours. This one experiment indicates that arsenate of lead may have killed the adults. Possibly, if reared adults had been used in these experiments, more definite results might have been obtained. This is a point which needs further study. To date no satisfactory control measure has been found for this troublesome pest.

Some Chemicals Attractive to Adults of the Onion Maggot (Hylemyia Antiqua Meig.) and the Seed Corn Maggot (Hylemyia Cilicrura Rond.)

ALVAH PETERSON, PH.D.

During the spring and early months of 1923, the author investigated the chemotropic response of the adults of the onion maggot and the seed-corn maggot to numerous chemicals. Those chemicals which produced odors that attracted flies were more thoroughly studied than those which repelled.

Only a brief summary of the more important positive results will be discussed in this report. For a more complete presentation of this investigation, see the "Journal of Economic Entomology," volume 17, pages 87-94.

Large numbers of adults of the onion maggot (*Hylemyia antiqua* Meig.) and the seed-corn maggot (*Hylemyia cilicrura* Rond.), were caught in the cages, possessing baits which contained small quantities of several alcohols, particularly allyl alcohol, isopropyl alcohol, ethyl alcohol and butylic alcohol. The same species of flies were also attracted in large numbers to cages where the baits contained yeast (a wet yeast "Fleischman's Yeast," or a dry yeast "Magic Yeast" or "Yeast Foam"), which gave off odors of fermentaion. The media used in the different tests were sweet substances, such as corn syrup, molasses, honey, brown sugar, cane sugar and several other sugars. The baits containing the alcohols remained attractive for a short period (24 to 48 hours) only, while the baits possessing yeast organisms continued to be attractive over a long period of time (14 to 21 days), provided they did not become too dry.

Several poisons were added to the most attractive baits, particularly the yeast baits. Mercuric chloride and formaldehyde in the yeast baits killed the yeast organism, and, consequently, reduced the attractiveness of the bait. Several other stomach poisons, sodium fluoride, sodium cyanide, nicotine sulfate, hellebore and extracts of derris were tried to a limited extent. In most of the trials there was a reduction in the attractiveness of yeast baits, where the respective poisons were added in small amounts.

Sodium arsenite was given the most thorough test. Where sodium arsenite in moderate amounts (1¼ ounce to 1 quart of media) was added to the baits containing the different alcohols, there was little or no perceptible change in the results, while a similar amount added to a yeast bait brought about a marked dimunition in the attractiveness of the bait. This was probably due to the fact that the arsenic killed the yeast organism. Further experiments seemed to indicate that a smaller amount of sodium arsenate (¼ ounce to 5 quarts of media) might be used, without reducing the attractiveness of the bait, and also be of sufficient strength to kill the flies which fed upon it. Baits containing wet yeast were less affected by the sodium arsenite than baits containing dry yeast. Further study may show that there is a difference in the lethal dosage of sodium arsenite for yeast organisms and for the adult of the onion maggot and the seed-corn maggot.

Report of the Cranberry Substation

CHARLES S. BECKWITH

Plant-Food

The cranberry substation continued the plant-food studies started 5 years ago, the soil-acidity studies started 6 years ago, the cranberry girdler control experiments started 2 years ago and the spraying experiment started last year. New work started this year consisted of an experiment to test the effect of various heights of water table on the cranberry plant. A formula for frost prediction has also been established.

The Effect of Nitrogen on Savannah Cranberry Land

This study is in its fifth year, and all treatments were made annually during that time. The results are given in table 5.

TABLE 5

Effect of Nitrogen on Savannah Cranberry Land

	TREATMENT lbs. per acre		

Complete Fertilizer for Savannah Cranberry Land

This is the fifth year in the test of a complete fertilizer for Savannah cranberry land. The mixture, as improved last year, is made up as follows:

140 pounds nitrate of soda.
300 pounds rock phosphate.
50 pounds sulfate of potash.

This formula is roughly 4-15-5.

The first year of the test, 300 pounds of acid phosphate was added to the above mixture.

The treatments and yields are given in table 6.

TABLE 6

Treatments and Yields of Complete Fertilizer for Savannah Cranberry Land

Plot No.	TREATMENT lbs. per acre	Yield per acre	Gain
		lbs.	*per cent*
1	Nothing	5208	....
2	264 pounds mixture	9924	87
3	Nothing	5404	....
4	528 pounds mixture	13512	152
5	Nothing	6736	....
6	792 pounds mixture		
7	Nothing		

Report of the Cranberry Substation

CHARLES S. BECKWITH

Plant-Food

The cranberry substation continued the plant-food studies started 5 years ago, the soil-acidity studies started 6 years ago, the cranberry girdler control experiments started 2 years ago and the spraying experiment started last year. New work started this year consisted of an experiment to test the effect of various heights of water table on the cranberry plant. A formula for frost prediction has also been established.

The Effect of Nitrogen on Savannah Cranberry Land

This study is in its fifth year, and all treatments were made annually during that time. The results are given in table 5.

TABLE 5

Effect of Nitrogen on Savannah Cranberry Land

Plot No.	TREATMENT lbs. per acre: Material	TREATMENT lbs. per acre: Nitrogen Equivalent	Yield per acre	Gain
			lbs.	*per cent*
1	Nothing	....	5032	....
2	140 lbs. Nitrate of Soda	20	10756	166
3	Nothing	....	2692	....
4	70 lbs. Nitrate of Soda, 85 lbs. Dried Blood	20	5764	49
5	Nothing	....	4032	....
6	170 lbs. Dried Blood	20	8484	45
7	Nothing	....	7668	....
8	210 lbs. Nitrate of Soda	30	14044	107
9	Nothing	....	5884	....
10	105 lbs. Nitrate of Soda, 127½ lbs. Dried Blood	30	10096	131
11	Nothing	....	3748	....
12	255 lbs. Dried Blood	30	7640	69
13	Nothing	....	5208	....

Check plots 3 and 11 had an unusually small crop on them this year, which gave the contiguous-treated plots unusually high percentage gains, but the general effect of the application is very obvious. It is well supported by the results of previous years.

Complete Fertilizer for Savannah Cranberry Land

This is the fifth year in the test of a complete fertilizer for Savannah cranberry land. The mixture, as improved last year, is made up as follows:

140 pounds nitrate of soda.
300 pounds rock phosphate.
50 pounds sulfate of potash.

This formula is roughly 4-15-5.

The first year of the test, 300 pounds of acid phosphate was added to the above mixture.

The treatments and yields are given in table 6.

TABLE 6

Treatments and Yields of Complete Fertilizer for Savannah Cranberry Land

Plot No.	TREATMENT lbs. per acre	*Yield* per acre	Gain
		lbs.	*per cent*
1	Nothing	5208	....
2	264 pounds mixture	9924	87
3	Nothing	5404	....
4	528 pounds mixture	13512	152
5	Nothing	6736	....
6	792 pounds mixture	17208	167
7	Nothing	6120	....
8	1056 pounds mixture (omitted in 1920 only)	13388	173
9	Nothing	5128	....

The results check very closely with those of previous years.

The increases following fertilizer treatments have been accomplished in 4 ways: in increasing the size of the fruit, in increasing the ability of the individual tips to bear fruit, in increasing the number of fruits per tip, and in increasing the number of tips per square foot.

Previous results shown have indicated that berries on the treated plots have averaged 20 per cent larger than those on the untreated plots.

During the last 2 years records of individual tips have been kept by marking 100 tips on plot 6 treated and plot 9 untreated. The record of their fruit production is given in table 7.

TABLE 7

Fruit-production Record

	Untreated	Treated
Number of tips bearing fruit both years	12	26
Number of tips bearing fruit one year only	64	62
Number of tips that did not bear fruit	24	12
Per cent of fruit production	44	57
Increase in per cent fruit production	....	30

The actual number of berries per fruiting tip on the treated plot averaged 2.5, while on the untreated plot it averaged 2, thus showing a gain of 25 per cent in favor of the treated plot.

The number of tips on a square foot of untreated bog was 150 and on the treated plot 250, an increase of 67 per cent.

Phosphoric Acid on Muck Cranberry Land

This is the fourth year of the treatments on muck cranberry land. The treatments and results are given in table 8.

All plots received in 1919 an application of acid phosphate equivalent to the application of rock phosphate in addition to the regular treatment.

As there was no noticeable difference in the vegetation on the plots, it was a surprise to find a definite difference in the yields. We may say, at least, that an overdose of rock phosphate on bogs of this character is not harmful.

TABLE 8

Phosphoric Acid Treatments and Results on Muck Cranberry Land

Plot No.	TREATMENT lbs. per acre		Yield per acre	Gain
	Material	P_2O_5		
			lbs.	*per cent*
1	Nothing	....	12568	....
2	75 pounds Rock Phosphate	10	13856	9
3	Nothing	....	13056	....
4	150 pounds Rock Phosphate	20	13804	8
5	Nothing	....	12442	....
6	225 pounds Rock Phosphate	30	14180	9
7	Nothing	....	12116	....
8	300 pounds Rock Phosphate	40	13804	12
9	Nothing	....	12052	....

Fertilizer for Muck Cranberry Land

The effect of various plant-foods on muck cranberry land was tested on a bog in which the plants were but 6 years old. The treatment was made in 1920 and the yield has been recorded since that time. Up until this year, the treatments have depressed the yield, but, now that the more vigorous action is over, there remains a beneficial result.

The plots are all in duplicate, and in table 9 there is recorded the average of the two plots with similar treatments. The percentage increases only are included.

Of the plots showing a loss, two (12 and 14) were over-fertilized, and the other two (9 and 10) had no phosphoric acid application. These results would make one think that potash had no beneficial effect on the size of crop, and that the best results may be obtained by a mixture of nitrogen and phosphoric acid. A 10-30 mix seems to be as good as anything, and this is equivalent to 75 pounds of nitrate of soda and 125 pounds of rock phosphate. Due to the unequal yields on the check plots, these results are not so definite as we would like to have them, and we hope to get closer results this year, as the plants are another year older.

TABLE 9

Average Effect of Various Plant-Foods on Two Plots of Muck

Plot	TREATMENT			Increase
	N	P_2O_5	K_2O	
				per cent
1	15	0	0	16.0
2	10	30	0	26.5
4	5	60	0	18.5
5	0	90	0	22.5
6	0	60	5	31.0
7	0	30	10	12.0
9	0	0	15	—31.5
10	5	0	10	— 5.0
11	10	0	5	5.0
12	15	90	15	—28.0
14	15	90	10	— 8.5
15	10	90	15	12.0
16	15	60	15	15.0
17	10	60	10	9.5
19	10	30	10	31.0
20	5	60	5	20.0

Soil Acidity Studies

The plots treated with ground limestone in 1918, 1919 and 1920 show little difference from the untreated plots. Data will be kept for several years, but, if there is no difference between the plots in the future, the detailed crop will not be reported.

Control of Cranberry Rot (Guignardi vaccinii Shear)

This is the second year of the spraying experiment at Hammonton. Last year the berries all rotted before harvest, although the berries on the sprayed plots did last much longer than on the unsprayed plots. The treatment and results of this year's work are given in table 10.

It is evident that the fungicide applications have made remarkable improvements in the fruit production of the plots so treated. The rot occurring in the harvested fruit is too much even now, and, with additional applications next year, it is hoped that this rot will almost disappear.

Insect Investigations

One insect experiment is worthy of note. Continuing the summer flooding experiments for control of cranberry girdler (*Crambus hortuellus* Hbn.) reported last year, we found that spraying with Bordeaux mixture just before and just after the flooding, reduced the damage to the berries materially. Due to this change, the bogs that

TABLE 10

Treatment and Results of Spraying Experiment at Hammonton*

Plot No.	TREATMENT	Yield per acre	Rot in November
		lbs.	*per cent*
1	Sprayed 4 times	9700	30
2	Nothing	0	....
3	Sprayed 4 times	8550	30
4	Sprayed 3 times	7600	30
5	Nothing	0	....
6	Sprayed 3 times	7850	30
7	Nothing	0	....

* Sprayings were made June 25, July 9, 23, and August 6. In plots 4 and 6 the August 6 spraying was omitted.

Spray material was bordeaux mixture 4-4-50 in which was dissolved 2 pounds of resin (fish-oil soap). This was applied at the rate of 250 gal. per acre.

were flowed in August, 1923, bore crops relatively free from the rot damage that followed the summer-flooding treatments of 1922. The station does not recommend this treatment generally, but when it is necessary, due to lack of water in September or other cause, it is a valuable aid in fighting the cranberry girdler.

The pollination of the cranberry blossom has never been studied closely in New Jersey, although for a number of years it has been thought advisable to keep honey bees nearby to aid in this work. Studies during the year, however, indicated that the pollination was carried out almost entirely by bumble bees and that there were

enough of these insects present to pollinate bloom for a good-sized crop every day. There were 320 bees actually working on an average acre, and each one visited, on the average, 14 flowers per minute.

The Water-Table Study

The water-table study was carried on this year by holding the water at different levels on various parts of a bog and noting the results on the vines and crops. On some plots the water was held at the surface of the ground, on others 3 inches below. The chief difference this year was in the amount of rot on the various plots. The result is given in table 11.

These results indicate that the water shuold be held at least 12 inches below the surface in order to prevent excess rot. It must be remembered, however, that this is only a trial of one year, and that we will have more complete information both in crop and vine conditions by another year.

TABLE 11

Water-Table Results

Depth of water below surface	Rot
inches	*per cent*
0	35.7
3	27.3
6	25.0
9	16.2
12	7.2
15	9.0

Investigation of the Biology of Sewage Disposal

This project is a joint effort of the New Jersey State Department of Health and the New Jersey State Agricultural Experiment Station. Because of its joint nature and the large volume of results to be reported, it has been deemed wise to issue the report of activities as a separate publication. Those who are interested will find the facts set forth in detail in the special separate joint report.

Soil-Infesting Insect Investigations

As set forth in the annual report for 1922-23, wire-worms have become a serious problem with market garden growers, and, to a less extent, with the operations of truckers. In fact, it is believed that the wire-worm damage has been increasing markedly during each of the last 3 years.

In the report for the year 1922-23 was set forth the negative results obtained by feeding wire-worms corn seed which had been treated with arsenicals and various other inorganic and organic poisons. Until a physiological investigation of the wire-worm's digestion could be undertaken, it seemed hopeless to pursue this lead further, and, consequently, attention was turned to the gassing process.

Carbon Bisulfide

Experiment 1

Six 500-cc. Erlenmeyer flasks were employed. In each flask was suspended a screen-wire cylinder 2.5 inches long by 0.75 inches wide, stoppered at both ends by corks, in which 2 vigorous wire-worms were placed. The stopper of flask 1 was removed and 0.02 gm. of carbon bisulfide was dropped into the bottom of the flask. The stopper, from which the cylinder was suspended, was then promptly replaced. Flask 2 received 0.04 gm., flask 3, 0.06 gm., flask 4, 0.08 gm., flask 5, 0.10 gm., and flask 6 no carbon bisulfide whatever. The experiment was set up on June 26, 1923, and allowed to stand 24 hours. The temperature at the start was 92° F., and, when closed, was 82° F. All larvæ in all the flasks were dead, showing that exposure of the wire-worms to these conditions for the period mentioned resulted in their death, regardless of the presence of carbon bisulfide.

Experiment 2

On July 2, 1923, this experiment was repeated with the addition of placing in each screen-wire cage 1 inch of moist soil to afford the larvæ protection from drying out and from heat. At the beginning of this experiment the temperature was 72° F. After 24 hours the larvæ were carefully examined. The results are shown in table 12.

TABLE 12

Results of Carbon Bisulfide on Wire-worm Larvæ

Flask No.	Dosage	No. Dead	No. Alive
	gm.		
1	.02	2	0
2	.04	2	0
3	.06	2	0
4	.08	2	0
5	.10	2	0
6	None	0	2

Obviously, the lowest dosage is lethal to two-thirds grown wire-worms, and, curious enough, this is the same dosage which is lethal to white grubs that are one-half to two-thirds grown.

TABLE 13

Effects of Various Carbon Bisulfide Treatments on Wire-worms

Plot No.	TREATMENT	Alive				Dead			
		1 inch	6 inches	9 inches	12 inches	1 inch	6 inches	9 inches	12 inches
1	½ ounce carbon bisulfide in emulsion form....	2	0	0	0	1	3	3	3
2	2 ounces carbon bisulfide in emulsion form.......	0	0	0	0	3	3	3	3
3	½ ounce carbon bisulfide not emulsified	3	2	2	3	0	1	1	0
4	2 ounces carbon bisulfide not emulsified	3	0	1?	0	0	3	2	3
5	Same as Plot No. 1...	Lettuce plant alive but lower leaves seemed injured. Grower considered lettuce unhurt by treatment.							
6	No treatment	3	3	3	3	0	0	0	0
7	15 quarts of water.....	Lettuce looked very fresh and healthy. Lower leaves not damaged.							

NOTE.—Large numbers of bibio fly larvæ were found dead at 6 inches to 9 inches below the surface. One white grub was found dead in plot 2 at 6 inches below the surface.

Experiment 3

In the spring of 1924 wire-worms were found in large numbers doing damage to lettuce which had been set in cold frames on Mr.

sion, applied when diluted with 1½ quarts of wate promptly by 13.5 quarts of water. This was intend actual dosage of 0.5 liquid ounces per square foot, b of fact, figures out a little less. Plot 2 received standard carbon bisulfide emulsion applied in exactly as above. This dosage was intended to represent 2 li actual carbon bisulfide per square foot. Plot 3 wa 13 cc. of actual carbon bisulfide applied at the center 4 inches deep. This dosage was intended to represent a ounce of actual carbon bisulfide per square foot. treated with 52 cc. of carbon bisulfide applied at the c about 4 inches deep. This dosage was intended to rep ounces of actual carbon bisulfide per square foot. treated with the same dosage and in the same way a 6 received no treatment whatever. Plot 7 recei quarts of water. Plots 1, 2, 3, 4 and 6 were su wire-worms. Three were placed at the 12-inch level, level, 3 at the 6-inch level, and 3 at the 1-inch level. enclosed in a screen-wire cylinder, containing about and the ends were stoppered with corks. At the time t was set the soil temperatures were: One inch down- inches down—42° F., 5 inches down—39.2° F. T medium heavy loam well charged with manure, and a as it could be and still be in good working conditio were dug up April 7 at the end of 72 hours. The resul in table13.

· The wire-worms were all at least half-grown, and about two-thirds. After digging them up they were boxes with moist soil and kept under observation fo period of 36 hours. During this period there was no c condition recorded in table 13.

This set of experiments seems to show that the ap ounce of carbon bisulfide in the emulsion form, wh heavy watering, destroys the majority of the wire-worm as 12 inches below the surface. A dosage of 2 ounces in emulsion form destroys 100 per cent. It may the the optimum dosage for these insects, under these c somewhere near 1 ounce per square foot. This table a carbon bisulfide in the non-emulsified form requires a per square foot to obtain the same results.

Experiment 4

The preceding set of experiments seem to leave a to the exact dosage, and two new plots, each about 5 feet wide were laid out in a cold frame. Eight wi

3-inch level, 2 on the 6-inch level, 2 on the 9-inch level and 2 on the 12-inch level. Plot 1 was then treated with 0.25 ounces of carbon bisulfide, in emulsion form, in 2 quarts of water to the square foot, and enough water was added to make 3 gallons per square foot. Plot 2 was treated with 0.5 ounces of carbon bisulfide in exactly the same was as plot 1. The soil temperatures had not changed, and may, therefore, be taken as practically the same as those which obtain in experiment 3. This experiment was set up on April 11, 1924, and was dug up 4 days later. In plot 1 one worm was found alive on the 3-inch level, 1 worm alive on the 9-inch level, 1 worm dead on the 3-inch level, 2 worms dead on the 6-inch level, 1 worm dead on the 9-inch level and 2 worms dead on the 12-inch level. In plot 2 two worms were found dead on the 3-inch level, 2 dead on the 6-inch level, 2 dead on the 9-inch level and 2 dead on the 12-inch level.

This experiment seems to show that, under cold-frame conditions such as these, a dosage of 0.5 ounces carbon bisulfide per square foot, when driven in with sufficient water, affords the destruction of 100 per cent of the larvæ.

Experiment 5A

The work in the cold frames at Mr. Rivicki's place was carried on while the wire-worms were well distributed through the surface soil. In view of the success indicated in destroying wire-worms in soils at a relatively low temperature, and in view of the probable danger of injuring plants with the carbon bisulfide, an effort was made to secure information on the efficiency of this material in the trucking land not covered by cold frames. For this purpose the experiments were moved from Oradelle to Richfield and the work carried on on the farm of Mr. Ollwerther, where the wire-worms were found still to be in the upper layer of the subsoil. This soil was of a stiffer loam type than the Oradelle soil, and it contained the maximum water which would permit its being worked with plows and harrows. On April 13, three plots were laid off on soil that had been previously plowed and harrowed once. Plot 1 was 20 feet long by 20 feet wide. Plot 2 was 8 feet long by 20 feet wide and plot 3 was 8 feet long by 12 feet wide. Plot 1 received injections of carbon bisulfide at points 6 inches apart and 3 or 4 inches deep. Sufficient of the material was introduced to give a trifle over 1 ounce to the square foot. Plot 2 received injections of raw carbon bisulfide at points 6 inches apart and 3 to 4 inches deep. Enough of the material was applied to give approximately ½ ounce to the square foot. Plot 3 received no treatment whatever. In each plot 4 wire-worms were planted, each wire-worm being enclosed in a small screen-wire cylinder which had been two-thirds filled with moist soil. Two were planted 4 inches below the surface, and two 8 inches below the surface. The soil temperature 1 inch down was 42.3° F., 5 inches down, 41.4° F. and 9 inches down 39.7° F. Four days later the planted worms were dug up with the results shown in table 14.

TABLE 14

Effects of Four-day Carbon Bisulfide Treatments on Wire-worms

Plot No.	NATURE OF TREATMENT	Number Alive				Number Dead			
		4 inches down	4 inches down	8 inches down	8 inches down	4 inches down	4 inches down	8 inches down	8 inches down
		Apparently alive	Died later	Apparently alive	Died later	Apparently dead	Revived later	Apparently dead	Revived later
1	Raw carbon bisulfide 1.0 liquid oz. per sq. ft., introduced at points 6 inches apart, 4 inches below the surface	0	....	0	....	2	1	2	1
2	Raw carbon bisulfide 0.43 liquid oz. per sq ft., applied as in Plot No. 1........	0	....	0	....	2	2	2	2
3	No treatment	2	0	2	0	....	....	....	....

TABLE 15

Effects of Six-day Carbon Bisulfide Treatments on Wire-worms

Plot No.	NATURE OF TREATMENT	Number Alive				Number Dead				No. Escaped
		4 inches down	4 inches down	8 inches down	8 inches down	4 inches down	4 inches down	8 inches down	8 inches down	
		Apparently alive	Died later	Apparently alive	Died later	Apparently dead	Revived later	Apparently dead	Revived later	
1	1 gallon of water per square foot	3	0	3	0	......	......	......	......	......
2	0.25 oz. carbon bisulfide in emulsion form in 1 qt. of water *to the square foot, fol*lowed by enough water to make a total of 0.5 gallon per square foot	......	......	......	......	2	0	2	0	2
3	0.25 oz. carbon bisulfide in emulsion form in 1 quart of water to the square foot. followed by enough water to make a total of 3 gallons to the square foot	......	......	......	......	3	1	3	2	......
4	0.25 oz. carbon bisulfide in emulsion form in 1 quart of water to the square foot, followed by enough water to make a total of 1 gallon to the square foot	......	......	......	......	3	2	3	0	......
5	0.5 oz. carbon bisulfide in emulsion form in 1 quart of water to the square foot, followed by enough water to make 1 gallon to the square foot	......	......	......	......	2	0	3	0	1

Thus, it appears that raw carbon bisulfide must be used under these conditions at more than 1 ounce per square foot if anything like a complete kill of the wire-worms is to be expected.

Experiment 5B

In view of the comparatively greater efficiency of carbon bisulfide in emulsion form in previous experiments, it was decided to run a test of that material. Five plots were selected. The ground was slopping and it was necessary to surround each plot with a low dike and to level its surface. Plot 1 was 29 inches long by 12 feet wide. Plot 2 was 4 feet long by 12 feet wide and plot 3 was 42 inches long by 12 feet wide. Plot 1 received no treatment whatever, other than 1 gallon of water per square foot. Plot 2 received 0.25 ounces of carbon bisulfide in emulsion form in 1 quart of water, followed by sufficient additional water to make a total of ½ gallon to the squart foot. Plot 3 received 0.25 ounces of carbon bisulfide in emulsion form in 1 quart of water, followed by enough additional water to make a total of 3 gallons to the square foot. Plot 4 received 0.25 ounces of carbon bisulfide in the emulsion form in 1 quart of water to the square foot followed by enough water to make 1 gallon to the square foot. Plot 5 received 0.5 ounces of carbon bisulfide in emulsion form per square foot in 1 quart of water, followed by sufficient additional water to make a total of 1 gallon per square foot. In each plot 6 wire-worms were placed, each enclosed in the usual screen-wire cylinder two-thirds filled with soil and stoppered with cork stoppers. Three were placed 4 inches below the surface and three 8 inches below the surface. The soil temperatures were: one inch down 38.6° F., 4 inches down 39.2° F. and 7 inches to 8 inches down 38.1° F. This experiment was established on April 16 and was dug out on April 22, leaving the wire-worms in the soil for a period of 6 days. The results are set forth in table 15.

Table 4 indicates that, under these conditions, a dosage of at least ½ ounce per square foot should be used. These data, when taken in connection with that derived from the cold-frame work at Mr. Rivicki's place, indicate that the proper dosage, under these conditions, is nearer 1 ounce of carbon bisulfide per square foot. This table also indicates that there is no particular advantage in using more water than 1 gallon to the square foot.

Experiment 6

The next question to be settled was could wire-worms in the upper layers of the subsoil be killed by surface treatments, without the use of large quantities of water, providing a sufficient amount of water were used to establish a continuously wet carbon bisulfide emulsion and water zone at a 4-inch level. If such were the case, it would prove practical to fight the wire-worms after the land had been plowed

and before they had emerged from the subsoil, and, consequently, before there was occasion for setting the plants in the soil. To answer this question 3 plots were laid off. Plot 1 was 12 feet long by 14 feet wide, plot 2 was 6 feet long by 14 feet wide and plot 3 was 6 feet long by 14 feet wide. Plot 1 was treated with 0.25 ounces of carbon bisulfide in 1 quart of water to the square foot. A furrow was struck crosswise the plot 4 inches deep. The carbon bisulfide emulsion in the above-mentioned amount of water was poured into this furrow in an amount to give the total above mentioned. As fast as the material ran into the soil, the furrow was hoed shut and a new furrow 9 inches away created. This furrow was treated in the same way as the first, and so on until the plot was covered. Actual examination showed that this method in this soil produced a continuously wet zone 3 to 4 inches below the surface of the soil, leaving the surface soil dry. Plot 2 was treated in the same way with 0.5 ounce of carbon bisulfide in emulsion form in 1 quart of water to the square foot. Plot 3 was treated with water only at the rate of 1 quart to the square foot, but the water was put on in exactly the same way as in plots 1 and 2. In each plot 9 wire-worms were planted; three 4 inches deep, three 8 inches deep and three 12 inches deep. As usual, each worm was enclosed in a screen cylinder which was about two-thirds filled with moist soil and stoppered at the ends with cork stoppers. The soil temperatures were: 1 inch down 48° F., 4 inches down 46° F., 8 inches down 44° F., and 12 inches down 43° F. This experiment was set on April 17 and dug up on April 22, subjecting the worms to exposure for a period of 5 days. The results are set forth in table 16.

Table 16 seems to show that the dosage for wire-worms, under these conditions, is something over one-half ounce per square foot.

Experiment 7

It seemed probable that the most practical way to treat soils infested with wire-worms for the destruction of these worms, while they were still in the upper layers of the subsoil, was at plowing time, and, consequently, a set of experiments was undertaken to obtain some facts bearing upon this idea. The piece of land selected was not utilized until after the completion of the experiments mentioned above, and, consequently, the temperatures of the soil were not lower than those recorded in experiment 6. Two plots were laid off, one for a check (100 feet long by 6 feet wide) and one for a treatment (110 feet long by 6 feet wide). Plot 1 received no treatment whatever, either before or after plowing. Plot 2 received 0.37 ounces of carbon bisulfide in emulsion form and 1 quart of water per square foot applied in the furrow ahead of the passage of the plow, so that it was promptly covered by an 8-inch thick furrow slice. The soil contained as much water as it could and still be in a workable condition. This experiment was carried out on Mr. Ollwerther's place in Richfield in

TABLE 16

Effect of Five-day Carbon Bisulfide Treatments on Wire-worms

	NATURE OF TREATMENT	Number Alive						Number Dead						No. Escaped
		4 inches down	4 inches down	8 inches down	8 inches down	12 inches down	12 inches down	4 inches down	4 inches down	8 inches down	8 inches down	12 inches down	12 inches down	
		Apparently alive	Died later	Apparently alive	Died later	Apparently alive	Died later	Apparently dead	Revived later	Apparently dead	Revived later	Apparently dead	Revived later	
	0.25 oz. carbon bisulfide in emulsified form in 1 quart of water per square foot, placed in drill rows 9 inches apart 3 inches to 4 inches deep	......	......	......	......	1	0	3	0	3	0	2	0	......
2	0.5 oz. of carbon bisulfide in 1 quart of water per square foot, applied as in plot 1	1	0	......	......	0	......	2	0	3	0	3	0	......
3	1 quart of water per square foot applied as in plots 1 and 2	3	0	3	0	2	0	......	......	......	......	......	......	1

soil of the same character as mentioned previously. Ten wire-worms were placed in each plot, five 4 inches below the surface and five 12 inches below the surface. Each worm, as usual, was enclosed in a screen-wire cylinder two-thirds filled with moist soil and stoppered at the ends with cork stoppers. This plot was set up on May 2 and examined on May 7. In plot 1 all 10 wire-worms were found alive. In plot 2 five were found alive at the 4-inch level, but 1 died later, 5 were found apparently dead at the 12-inch level, but 3 revived later, indicating that the dosage in this case should have been, at least, ½ ounce of carbon bisulfide to the square foot, and probably, in view of previous results, nearer 1 ounce than ½ ounce per square foot.

About May 5, 1924, these plots were planted to beets. Examination of these plots later showed distinctly that, while very few beet plants had been destroyed by wire-worm, all had been seriously checked. Obviously, not enough time had gone by after the treatment before the beets were set. On this latter date the other plots at Mr. Ollwerther's place were examined, and it was found that the treatment with raw carbon bisulfide injections, with carbon bisulfide emulsion driven in with large amounts of water, and carbon bisulfide emulsion applied with 1 quart of water to the square foot, showed no checking of the plants whatever, and a very high degree of protection from wire worms as evidenced in the extremely small percentage of plants lost by their work. It was also evident that where the carbon bisulfide emulsion was driven in with water, the loss of plants by wire-worms was the smallest. In none of the instances could the loss be considered serious, while in the untreated portions of the bed, at least, 50 per cent of the plants were gone.

Experiment 8

The occurrence of infestation and injury of early cabbage by wire-worms at Mr. Shiver's farm near Haddonfield, N. J., gave us an opportunity to test the effect of carbon bisulfide emulsion in the destruction of wire-worms and injury to plants.

Three plots were laid out, each consisting of 1 row of cabbage, and a fourth plot was selected, consisting of 3 rows of cabbage. Plot 1 received 1.0 ounce of carbon bisulfide in the emulsion form per linear foot, plot 2 received 0.5 ounce of carbon bisulfide per linear foot, plot 3 received 0.2 ounce of carbon bisulfide per linear foot and plot 4 received no treatment whatever. The carbon bisulfide emulsion was diluted with water to a sufficient extent to permit the application of the proposed dosage in 1 quart of water to the linear foot. A furrow was opened along each side of the cabbage row as close to the plants as was practicable. One pint of the mixture per linear foot was poured into one furrow and 1 pint per linear foot was poured into the second furrow. This procedure established a wet zone from the outside of one furrow to the outside of the other furrow.

TABLE 17

Effect of Carbon Bisulfide Emulsion on Wire-worms and Plants

TREATMENT	Planted Worms					Results on Examination of 5 Plants												Plant Condition
	Apparently alive	Died later	Apparently Dead	Revived	Escaped	First Plant		Second Plant		Third Plant		Fourth Plant		Fifth Plant		Total		
						A	D	A	D	A	D	A	D	A	D	A	D	
1.0 oz. Carbon bisulfide in emulsion form in 1 quart of water to the linear foot..	1	0	4	0	....	....	2	....	....	....	4	....	3	....	3	0	12	No apparent injury
0.5 oz. Carbon bisulfide in emulsion form in 1 quart of water to the linear foot..	1	0	3	0	1	....	....	4	1	7	....	....	....	....	....	11	1	No apparent injury
0.25 oz. Carbon bisulfide in emulsion form in 1 quart of water to the linear foot..	2	0	2	0	1	....	....	7	....	....	6	4	....	5	....	16	6	No apparent injury
No treatment	5	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	No apparent injury

Note.—A—Alive. D—Dead.

These furrows were promptly hoed shut. Five wire-worms were introduced in the usual way into each plot at a depth of 2½ inches. The moisture in this soil was very high, but it was so sandy that, in spite of the recent rains, it was in good cultivating shape. The temperature of this soil ran slightly above 50° F. This experiment was started on May 14, 1924, and examined on May 20, 1924.

In taking the data, not only were the planted wire-worms dug up, but 5 hills of cabbage were examined in each plot. Table 17 sets forth the results.

Examination of table 17 serves to show that, under these conditions, the required dosage is not less than 1 ounce of carbon bisulfide emulsion per linear foot. Examination of this plot later showed that practically none of the cabbage plants were destroyed by any of the treatments, but that practically all of them were seriously checked.

Calcium Cyanide

Owing to the rapid evolution of hydrocyanic acid gas from calcium cyanide, under conditions which would normally be supplied by soil, and, especially, in view of the results obtained by Horsfall[2], it seemed desirable to make a study of its possibilities under field conditions.

Experiment 1

In a cold frame at Mr. Rivicki's place 3 plots were laid off. Each plot was composed of 2 furrows entirely across the cold frame, 6 inches apart. Each furrow was made 1 inch deep. The cyanide flakes were sifted into them and covered with soil at once. Plot 1 received calcium cyanide flakes at the rate of 1.5 ounces per square foot. Plot 2 received calcium cyanide flakes at the rate of 0.25 ounce per square foot and plot No. 3 received calcium cyanide at the rate of 0.5 ounce per square foot. Into each plot 12 wire-worms were introduced. Each worm was placed in a separate hole 1 inch deep and promptly covered. One-half of each plot was then wet down with water, making a division as follows: Not wetted with water, plots 1, 2 and 3, and wetted with water, plots 1(a), 2(a) and 3(a). The temperatures of the soil were: One inch down 45.3° F., 2.5 inches down 42° F., and 5 inches down 39.2° F. Growing in the section of cold frames utilized for this experiment were a number of lettuce plants each about 3 inches high and a large number of common weeds. The portion of the cold frame under experiment was set off from the balance of the frame by a cross-board. The experiment was set up on March 28 and the treatments were examined on March 31. The results are set forth in table 18.

All lettuce plants and weeds in the portion of the frame treated were killed and 2 rows beyond the cross-board were destroyed.

[2] Horsfall, J. L. 1924. Possibilities of granular calcium cyanide as a control measure for wire-worms. *In* Journ. Econ. Ent., v. 17, p. 160.

Table 18 indicates that the prompt application of water in connection with calcium cyanide treatments, under these conditions (soil in good workable condition), is highly advisable from the standpoint of destroying the wire-worms. If this is not done it seems that the wire-worms are able to crawl away from the danger zone before they are killed, even when high dosages of the material are employed. Table 18 also shows that calcium cyanide is very deadly, under these conditions, to the growth of plants, such as lettuce and many common weeds.

TABLE 18

Effect of Three-day Calcium Cyanide Treatments on Wire-worms

Plot No.	TREATMENT	Number worms alive	Number worms dead	Number worms revived	Number worms escaped
1	1.5 oz. calcium cyanide per square foot	....	....	0	6
2	0.25 oz. calcium cyanide per square foot	....	1	0	5
3	0.5 oz. calcium cyanide per square foot	....	1	0	5
1(a)	1.5 oz. calcium cyanide per square foot	....	6	0	....
2(a)	0.25 oz. calcium cyanide per square foot	....	6	0	....
3(a)	0.5 oz. calcium cyanide per square foot	....	6	0	....

Experiment 2

The calcium cyanide treatments having proved so deadly to plants in the cold frames, it was decided to see whether wire-worms could be destroyed by it in ordinary soils outside the cold frames, and a series of 2 experiments were planned. The first was a study of horizontal distribution and the second a study of both horizontal and vertical distribution of lethal amounts of gas.

Two plots were laid out in this experiment. In plot 1, 0.2 ounce of flake calcium cyanide was introduced into each of the two furrows, each 3 inches wide and 2 to 3 inches deep. The distance

from the inner edge of one furrow to the inner edge of the next furrow was 9 inches. The furrows were 24 inches long. Nine wire-worms were placed in a row 4½ inches from the outer edge of one furrow, 3 were placed 4 inches below the surface, 3 were placed 8 inches below the surface and 3 were placed 12 inches below the surface. A similar row was placed between the two furrows on a line exactly 4½ inches from the inner edge of each furrow. A similar line of wire-worms was placed on a line exactly 4½ inches from the outer edge of the second furrow. Each wire-worm was placed in the usual screen cylinder two-thirds filled with soil. The calcium cyanide flakes were sifted carefully in the bottom of these furrows and the furrows were filled with soil. Plot 2 received exactly the same treatment as plot 1, except that the furrows were made 6 to 7 inches deep. The temperature of the soil 1 inch below was 38.4° F., 2.5 inches below 37.8° F. and 5 inches below 37.3° F. The soil was full of water, in fact, contained a little too much water to make it work well. It was a medium heavy loam, and at the 12-inch level the water table seemed very close. This experiment was set up on April 11, 1924, and was dug up on April 21, 1924, leaving the worms under exposure for 10 days.

In plot 1, 9 worms were found alive at the 4-inch level, 8 worms at the 8-inch level and 9 worms at the 12-inch level. One worm was found dead at the 8-inch level, and that was in the row between the 2 furrows. In plot 2, 8 worms were found alive in the 4-inch level, 9 in the 8-inch level and 8 in the 12-inch level. One worm was found dead in the 4-inch level and 1 was found dead in the 12-inch level. Both of the dead worms were taken from the row between the 2 furrows. Thus, it seems that a dosage of .02 of an ounce of calcium cyanide flakes, under these conditions, is insufficient to destroy the worms.

Experiment 3

Three plots were laid out each 2 feet by 2 feet. The land employed for this experiment was adjacent to the piece used for experiment 2, and the soil temperature and water conditions were the same. Sixteen wire-worms were used in each plot and 8 were laid down along one diagonal, and 8 along the other diagonal. Starting at the center the worms were introduced at intervals of 3 inches apart. Four wire-worms were placed at the 3-inch level, 4 were placed at the 6-inch level, 4 at the 9-inch level and 4 at the 12-inch level. Each wire-worm was placed in the usual screen-wire cylinder. A hole was made at the center of each plot 6 inches deep and the calcium cyanide flakes were introduced into these holes and promptly covered with the moist soil. Plot 1 received 0.5 ounce of calcium cyanide, plot 2 received 0.1 ounce of calcium cyanide and plot 3 received 0.05 ounce of calcium cyanide per square foot. Table 19 gives the results.

TABLE 19

Effects of Calcium Cyanide on Wire-worms at Varying Depths in the Soil

Plot No.	3 in. away								6 in. away								9 in. away								12 in. away							
	3 in.		6 in.		9 in.		12 in.		3 in.		6 in.		9 in.		12 in.		3 in.		6 in.		9 in.		12 in.		3 in.		6 in.		9 in.		12 in.	
	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D
1....	...	1	...	1	...	1	...	1	...	1	1	1	...	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...
2....	...	1	...	1	...	1	...	1	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...
3....	...	1	1	...	...	1	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...	1	...

Table 19 serves to show that not less than 0.10 ounce of calcium cyanide flakes should be used, under these conditions, that the lateral distribution of lethal dosages of the gas extends as far as 3 inches and not as far as 6 inches, but that the vertical distribution of the gas, at least, to a depth of 12 inches, is eminently satisfactory. Of course, the kill is obviously a factor of dosage and of lateral distance from the source of lethal gas.

Experiment 4

In view of these results, it was deemed worth while to see whether calcium cyanide could be used for the destruction of wire-worms in the upper layers of the subsoil at the time that the ground is plowed, for this would give the maximum length of time between the treatment and the setting out of plants, allowing the greatest possible latitude for escape of the gas from the soil. Two plots were laid out at Mr. Ollwerther's farm. Plot 1 was 100 feet long by 5½ feet wide, and received 0.1 ounce of calcium cyanide flakes per square foot, applied in the furrows just ahead of the plow. Plot 2, which was 100 feet long and 5½ feet wide, received no treatment whatever other than the plowing. The soil here was as moist as it could be and still be in good workable condition. The soil was a heavier loam than that at Mr. Rivicki's place. The temperature of the soil was the same as that recorded for experiment 7 with carbon bisulfide. Ten wire-worms were put in each plot at regular intervals. Five were introduced before plowing to a depth of 12 inches and 5 were introduced after plowing to a depth of 4 inches. The experiment was established on May 2 and was dug up on May 7. In plot 1, 3 wire-worms were alive at the 4-inch level and 5 were alive at the 12-inch level. Two wire-worms were dead at the 4-inch level. In plot 2, 5 wire-worms were alive at the 4-inch level and 5 were alive at the 12-inch level. Obviously, the dosage in this case was insufficient to accomplish the desired results. These data, taken with that from the previous experiments, seem to indicate that the dosage of calcium cyanide, under outdoor conditions such as these, should exceed 0.1 ounce per square foot. A day or two previous to the digging up of this experiment beets were set out on the treated blocks. Examinations made later showed that most of the beet plants on the calcium cyanide treated area had been destroyed.

Experiment 5

In May, wire-worms made their appearance and were doing large damage to early cabbage on the farm of Mr. Shivers, near Haddonfield, N. J. It was promptly determined to see whether calcium cyanide could be used for destroying these worms and potecting the cabbage plants. The cabbage plants were about 5 inches high, and, where not infested with wire-worms, were growing vigorously. Seven plots of cabbage, each consisting of a single row, were employed.

These plots were selected in the worst-infested part of the field. Calcium cyanide was applied with a small truck crop seeder. By careful calibration of this seeder it was possible to sow a given amount of the calcium cyanide per linear foot. This seeder created a furrow, dropped the cyanide into it and filled the furrow with soil, introducing the cyanide about 1 inch below the surface. In all cases the cyanide-treated furrow was placed on each side of each row and as close to the row as the machine would permit. This meant, normally, that each furrow would average about 4 inches from the base of the plant. Plot 1 received 0.2 ounce of calcium cyanide per linear foot, plot 2 received 0.4 ounce of calcium cyanide per linear foot, plot 3 received 0.6 ounce of calcium cyanide per linear foot, plot 4 received 0.8 ounce of calcium cyanide per linear foot, plot 5 received 1.0 ounce of calcium cyanide per linear foot, plot 6 received 2.0 ounces of calcium cyanide per linear foot and plot 7 received no treatment whatever. In each plot 5 wire-worms, each enclosed in its usual screen-wire cage, were placed at a depth of 2 inches below the surface. The soil in this case was sandy and as wet as recent rains could make it. It was, however, so sandy that, in spite of the recent rains, it was in workable condition. The experiment was established on May 14 and the results were examined on May 20. In taking data, not only were the planted worms considered, but 5 plants in each plot were dug up and examined for the presence of wire-worms. The results are set forth in table 20.

Apparently, when calcium cyanide is applied in this way, under these conditions, a minimum dosage of 1.0 ounce per linear foot is required and results in serious injury to the cabbage plants.

Examination of these plots later showed that while the injury to the cabbage plants varied as the amount of cyanide applied, the lowest dosage, which was 0.2 ounce per linear foot, resulted in very serious injury, killing at least 75 per cent of the plants.

Discussion of Results

Although many specimens of wire-worms, from the various places where work was carried on, were sent to specialists we have thus far been unable to get a specific determination. In fact, the statements which we were able to obtain on a generic identity of these worms are uncertain. Mr. J. A. Hyslop, of the Bureau of Entomology, Washington, D. C., states that these worms belong to the *Elaterid* family of the genus *Melanotus*. An effort is now being made to rear adults from the worms collected at different points where the work was carried on.

Doubtless, gases other than carbon bisulfide and hydrocyanic acid gas could be used against wire-worms, but these gases seemed to be the most practical material at hand for tests when this work was undertaken. The practicability of using either material for destroy-

ing wire-worms, where general agricultural crops are concerned, may rightly be questioned, but the primary problem presented in this outbreak has been concerned with infestation in soils devoted to the growing market garden crops, from 1 acre of which as high as $1,000 worth of material can be produced in the course of a single year. In dealing with lands of this type the expenditure of $75.00 to $100.00 an acre for removing a limiting factor of this character is practicable, and would be readily adopted if the proper results from the expenditure could be guaranteed. In dealing with the problem in cold frames the financial margin of selling prices over crop protection costs is even greater.

In the course of the experiments with carbon bisulfide in cold frames, the material was compelled to work under a temperature ranging from slightly below 40° F. to slightly above 45° F. Under these conditions, the dosage apparently required was very little short of 1 ounce per square foot, and the best results followed the use of carbon bisulfide in the emulsion form, driven in with comparatively large quantities of water. The toxicity of the carbon bisulfide for plant growth was so markedly less than that of the calcium cyanide that it seems wisest in practice to recommend the use of the former.

The carbon bisulfide emulsion is a product worked out in connection with the Japanese beetle work for use against the Japanese beetle grub. Mr. B. R. Leach and Dr. Walter E. Fleming have been principally concerned in working out this mixture. The mixture is made by combining 1 part resin fish oil soap, by volume, 3 parts of water and 10 parts of technical carbon bisulfide. The soap is dissolved in the water. The carbon bisulfide is poured into the mixture and vigorously shaken until a creamy emulsion is formed. This is a stock solution and runs between 70 per cent and 71 per cent actual carbon bisulfide.

In view of the checking effect of this carbon bisulfide emulsion treatment, as shown on lettuce, beets and cabbage, the entomologist believes that the application should be made before the plants are put into the ground. So far as he can see, the treatment will be successful in the cold frames at any time of the year that the soil temperatures range around 50° or above, for, while the results would be more easily obtained when the worms are up in the cultivated slice, it seems quite possible to kill them in the upper layers of the subsoil. In dealing with this problem in cold frames he believes that the frames should be thoroughly forked over and cultivated before the treatment is applied, in order to facilitate penetration of the soil by the material. In dealing with wire-worms in trucking soils, outside of cold frames and other enclosures, the entomologist believes that the treatment should be made at the time the land is plowed or very shortly thereafter, and that a period of about one week in the case of carbon bisulfide, and longer in the case of the calcium cyanide, should elapse between the treatment and the setting out of the plants. Surface treatments must be employed if the application is not made until

TABLE 20

Effects of Six-day Calcium Cyanide Treatments on Plants and Wire-worms

Plot No.	TREATMENT	Planted Worms					Results on Examination of 5 Plants												Plant Condition
		Apparently alive	Died later	Apparently dead	Revived	Escaped	First Plant		Second Plant		Third Plant		Fourth Plant		Fifth Plant		Total		
							A	D	A	D	A	D	A	D	A	D	A	D	
1	0.2 oz. calcium cyanide per linear feet	1	0	....	....	4	....	5	....	5	3	....	8	....	9	....	20	10	No apparent injury
2	0.4 oz. calcium cyanide per linear feet	....	....	....	....	5	7	....	7	....	5	....	9	....	10	....	38	0	No apparent injury
3	0.6 oz. calcium cyanide per linear feet	....	....	....	....	5	7	1	....	4	2	....	6	....	9	....	24	5	Slight injury
4	0.8 oz. calcium cyanide per linear feet	1	0	1	0	3	4	3	6	....	7	3	5	....	....	16	22	22	Severe injury
5	1.0 oz. calcium cyanide per linear feet	....	....	....	....	5	....	6	....	6	....	9	2	7	....	4	2	32	Severe injury
6	2.0 oz. calcium cyanide per linear feet	....	....	....	....	5	....	5	....	7	....	16	....	12	3	5	3	45	Killed outright
7	No treatment	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	

Note.—A—Alive. D—Dead.

the plowing is completed. Furrow treatments may be utilized, if the treatment is made at the time the land is turned with the plow.

Without more experience, it is useless to attempt a discussion of the cost of the treatment. Carbon bisulfide can be purchased for 7 cents a pound in 50-pound drums, or for about 5 cents a pound in carload lots. The labor factor is the one which the entomologist finds himself unable to evaluate at this time.

Bee Investigations

RAY HUTSON

Introduction

The honeybee investigations for the year have consisted in the pursuance of the plans made at the inception of the work 2 years ago; namely, the determination of the relation of the honeybee to fruit growing; the cause or causes of certain bee diseases of obscure etiology; and the breeding of European foulbrood resistant and high-producing strains of honeybees.

The Relation of Honeybees to Fruit Growing

The investigations made in the western states by Tufts[3] and Hendrickson[4] of the California Station and by men at the Oregon and Washington Stations[5], as well as by Waite of the United States Department of Agriculture[6], indicate that honeybees are a large factor in fruit pollination. The observations made at this station last year point to the same conclusion. This year's work was undertaken for the purpose of obtaining confirmation of the work already done.

Apple Pollination

STUDIES NEAR GLASSBORO, N. J.

This year's studies were conducted in the orchards near Glassboro, N. J. A block of Winesap and Paragon apples, known self-sterile varieties not cross-fertile to each other, in the orchards of S. H. Stanger's Sons, was used for the study of honeybees in effecting a set of fruit in solidly self-sterile plantings. An interplanted block of Wine-

[3] Tufts, W. P. 1919. Pollination of the bartlett pear. Cal. Agr. Exp. Sta. Bul. 307.

[4] Hendrickson, A. H. 1921. Plum pollination. Cal. Exp. Sta. Bul. 310.

[5] Lewis, C I., and Vincent, C. C. 1909. Pollination of the apple. Oregon Agr. Exp. Sta. Bul. 104.

[6] Waite, M. B. 1895. Pollination of pear flowers. U. S. Dept. Agr., Div. Veg. Path., Bul. 5.

saps, every seventh row of which is Smith's Cider in Repp's New Ground orchard, was used for the studies on honeybees in effecting the set of fruit in mixed plantings of cross-fertile varieties.

The weather records given are those from the Philadelphia Station of the Weather Bureau. They are used on the advice of the Philadelphia and Trenton weather men, who were of the opinion that the slight differences in observations between Philadelphia and Glassboro would be more than counteracted by errors in instruments and amateur observations.

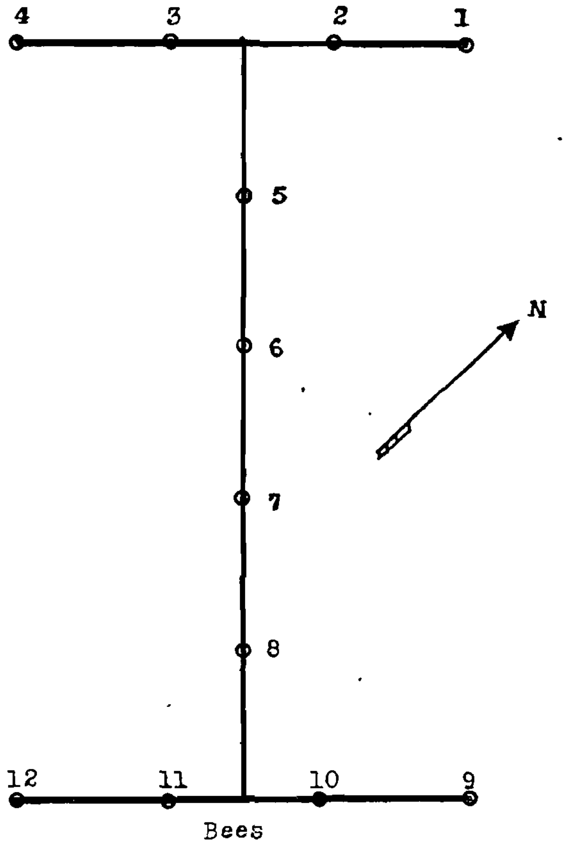


Figure 1

FIG. 1. Diagram of location of trees for counts in Stanger Orchard. Distance between circles 25 yards.

An effort was made to secure every insect other than a honeybee on the collection tours. Honeybees were not killed but counted on

the trees, as they do not move around enough when collecting nectar to cause a large error, but work all flowers in each cluster before moving to the next.

COLLECTIONS IN STANGERS' ORCHARD

Bees Placed May 3

May 13
2 bumblebees
8 Muscids
32 Chironomids
1 syrphid
Wind 7.8 N. W.
Mean Temp. 60
Humidity noon 50

May 14
3 bumblebees
20 Chironomids
7 syrphids
Wind 8.8 S. W.
Mean Temp. 65
Humidity noon 47

May 15.
2 bumblebees
15 Chironomids
1 syrphid
1 beetle (Scarabeidæ)
6 Muscids
Wind 10.1 N. W.
Mean Temp. 53
Humidity noon 45

DETERMINATION OF SET OF FRUIT (STANGERS')

In determining the set of fruit in the Stanger orchards, 12 trees were selected and arranged as in figure 1. The number of flowers was determined by collecting and counting the blossom stems which fell to the ground This was effected by actually counting 58,033 blossoms which were air-dried on top of a furnace for 5 days and weighed; from this the weight of a single stem was computed. The rest of the stems were dried 5 days or more on the furnace and the number of stems calculated As soon as the apples set were large enough to be seen easily they were counted. Table 21 gives the results of these counts.

TABLE 21

Results of Blossom and Apple-set Counts in Stanger Orchards

Tree Number	Blossoms	Number fruit set
1	7,593	2 4
2	4,476	6
3	8,982	5
4	4,260	2
5	7,602	3
6	6,186	6
7	9,822	7
8	7,602	9
9	5,801	8
10	3,987	11
11	5,407	17
12	6,592	4

COLLECTIONS IN THE REPP NEW GROUND ORCHARD

Bees moved out night of May 15

May 13.	May 14.	May 15.
4 Bumblebees	1 Bumblebee	3 Bumblebees
1 Wasp	10 Chironomids	11 Chironomids
13 Muscids	1 Syrphid	3 Syrphids
19 Chironomids	6 Muscids	7 Muscids
Wind 7.8 N. W.	Wind 8.8 S. W.	Wind 10.1 N. W.
Mean Temp. 60	Mean Temp. 65	Mean Temp. 53
Humidity noon 50	Humidity noon 47	Humidity noon 45

DETERMINATION OF SET OF FRUIT (REPP)

The set of fruit in the Repp new ground mixed Smith cider and winesap was determined by counting the total blossoms and the fruits set on selected trees at varying distances from the bee hives. At each given distance counts were made on a Smith cider and a winesap tree. The observations on the flight of bees in the orchard having shown that very few bees ventured more than 25 yards from the hives, the trees were selected at the hives, 25 yards away, 50 yards away and 75 yards away. The fallen winesap blossoms were collected, dried, weighed and the number calculated as in the Stanger orchard, while the Smith cider blossoms were counted outright as they were not of the same weight as the winesap blossoms. After the apples were large enough to be seen easily they were counted. Table 22 gives the results of these counts.

During the blooming period very unfavorable weather prevailed. The sky was overcast most of the time, with showers practically every day.

TABLE 22

Results of Blossom and Apple-set Counts in Repp Orchards

Distance from hives	Tree	Blossoms	Number fruit set	fruit set
yds.				*per cent*
At Hives	Smith Cider	12,372	129	1.0
	Winesap	7,623	212	2.7
25	Smith Cider	21,140	102	.4
	Winesap	8,559	187	2.1
50	Smith Cider	15,682	94	.6
	Winesap	6,891	69	1.0
75	Smith Cider	11,436	75	.6
	Winesap	5,421	81	1.4

Bees did not venture far from the hives. Twenty-five yards from the hives 4 bees were the most seen on one tree. One hundred and fifty yards was the farthest away from the hives a bee was seen during the period the bees were in the orchard. This condition, in the writer's opinion, vitiates the results to such an extent as to render them almost useless. The orchards in which the experiments were conducted have experienced other light sets, but the failure in the Stanger orchards can be ascribed to the coincidence of bad weather, otherwise the insects which effected the light set of other years could have done their work. A heavy set in the Stanger orchard was not expected because the winesap is self-sterile, but it was hoped to secure a better set about the been hives than at a distance from them. In the Repp orchard the blooming period did not coincide so completely with the bad weather, and the bees were left in the orchard until May 20. Most of the fruit set in the Repp orchards is from lateral blossoms. A comparison of the set shown by the tables is afforded by the statement of Morris[7], that a set of "9 to 11 per cent will ordinarily load the tree so that very heavy thinning is necessary."

Cranberry Pollination

During the cranberry blooming season of 1923, with Charles S. Beckwith, Cranberry Specialist, the writer made a study of the effect of the honeybee on cranberry pollination. In the study on cranberries the plan of using 12-mesh wire netting cages with bees and without bees and the making of collections of insects was followed. The cages enclosed equal areas of cranberry bog side by side. The cages were 71 inches square, inside measurement, and 6 feet high. One had a hive of bees, the other did not. At the end of the cranberry blooming period the total number of blossoms and the fruits set were determined and the percentages calculated. Table 23 gives the results.

TABLE 23

Total Number of Blossoms and Fruits Set Determined at End of Blooming Period

	Blossoms	Number Berries set	Berries set
			per cent
Cranberries with bees	2385	1335	56.0
Cranberries without bees	2184	185	8.4

[7] Morris, O. M. 1921. Studies in apple pollination. Wash. Agr. Exp. Sta. *Bul. 163.*

Collections on the Cranberry Bogs at Whitesbog, N. J.

On two different occasions collections on the cranberry bogs at Whitesbog were made. The manner in which the large number of bumblebees (mostly *Bombus impatiens*) worked led Mr. Beckwith and the writer to count the bees on the flowers instead of catching them in the cyanide bottles. The bumblebee in working cranberry flowers does not usually fly, but crawls from one flower to the next, which was seldom an inch away, on the bog where the observations were made. Ten counts were made on each of two days to determine the rate at which bumblebees work. The results appear as table 24.

TABLE 24

Number of Flowers Visited by a Bumble Bee in 1 Minute

July 7	July 11
13	9
17	16
14	15
12	13
10	9
10	11
13	12
14	12
9	9
9	11
Working average	11.9

TABLE 25

Bumblebees on Ten 5-rod Plots

Plot	Number Bumblebees	Other Insects
1	15	1 Andrenidæ
2	10	2 Muscids
3	13	
4	13	
5	16	
6	17	
7	17	
8	15	
9	18	
10	14	

The counting and collecting of insects were simplified by the fact that the bog was laid off by stakes into plots of 5 square rods for convenience in picking. The number of bumblebees on each of ten 5-rod plots is given in table 25.

Tables 24 and 25 indicate that in the region about Whitesbog the number of bumblebees is such as to be sufficient for the pollination of cranberries which bloom late enough for bumblebees to become numerous. Table 25 would indicate a population of between four and five hundred bumblebees per acre. Mr. Beckwith calculated that the population per acre in table 25, working at the rate of 11.9 per minute (table 24) for a 14-hour working day for bumblebees in July, could visit every flower every day of the blooming period for a crop much larger than the New Jersey average, using 43,560 as the number of cranberries per bushel.

The Disappearing Disease

The work on disappearing disease has not gone along very rapidly in the past year owing to the fact that only two authentic cases have been brought to the notice of the station. Other doubtful cases which were repored were found on investigation to be due to other causes. The first case occurred late in September, 1923, in the apiary of R. D. Barclay, near Columbus, N. J., the second in H. D. Mills's apiary at New Brunswick, N. J., in May, 1924. In each case arsenic was found in the dead bees in sufficient amounts (over .0002 mgm. per bee) to cause death. In neither case was arsenic present in honey from the hive. In the Mills case the bees were very low in stores on May 20 and 21, when the petal-fall spray was applied at the Agricultural Experiment Station about 3/8 of a mile away. On May 23, two hives of Mr. Mills's bees exhibited the symptoms of disappearing disease. Bees of all ages crawled in every direction from the hive in a sort of nervous haste and collected in little groups on sticks and depressions. These bees did not move when disturbed. Every one smashed had a full abdomen, the contents of which much resembled a bee with dysentery. The condition disappeared with the advent of a honey flow.

In trying to find out whether the disorder could be caused in bees by feeding, 500 mgm. of arsenic trioxide was administered to a shook swarm which built combs from the syrup containing the arsenic. Nothing happened, although the bees were constantly observed. Five hundred mgm. is enough to kill 2,500,000 bees, a number equal to 40 or 50 ordinary hives of bees, supposing that the minimum lethal dose for a bee were .0002 mgm.

Breeding Bees

The breeding of European foulbrood resistant and high-producing bees has been carried on during the year at the apiaries established for the purpose and at the bee-mating grounds at Chatsworth, Burlington County. Preparatory to breeding, a number of strains of bees have been tested out.

Disease Resistant Strains

The development of European foulbrood resistant bees has gone on faster, because a queen, which showed some resistance, was already among those in the disease yard at New Lisbon. This queen is a pure mated dark Italian. Nothing more is known of her, except that her bees have cleaned up an apparently hopeless case of European foulbrood and kept it cleaned, except for a few cells, for 3 seasons. This record, coupled with the fact that her bees are not very irritable and have had over 100 pounds of honey each year, has caused her selection as a breeder. Last year 3 of her daughters were permitted to mate at the apiary and 7 were taken to the bee-mating grounds along with drones from a colony headed by an imported Italian queen, which has shown only traces of European foulbrood, although exposed to it for 3 seasons. Three queens were mated, but 1 became crippled and was killed.

The queens mated at New Lisbon have not shown any marked resistance to European foulbrood. The queens mated at the mating grounds and have performed as follows:

August 2, 1923.—Seven virgin queens were taken to the bee-mating grounds in nuclei. Clethra was in bloom and a tub of 1 part sugar to 8 parts water with floating sticks to facilitate feeding was left near them, as feeding each nuclei separately had not been satisfactory on previous trials.

August 12.—Five more virgins were taken to the plains. Two of the queens taken down previously were mated. One was crippled and was killed; the normal one was brought back to New Lisbon and placed in a colony. The bees had gathered some nectar, presumably from Clethra.

August 28.—The plains were revisited and a nuclei-mated queen was brought away and placed in a colony. The other 4 had not mated.

The two queens mated on the plains were small and slim, but had good heads and action.

The 3 daughters of the queen designated as "P," mated at New Lisbon, are very nice looking queens, good size, large head, long abdomen, good color and good layers. Their larvæ, however, are attacked by European foulbrood to the extent that 1 was discarded this spring; the other 2 will be as soon as a queen-rearing colony can be built up. On May 28, this year, 2 virgins, raised in the upper story of the hive containing the imported queen, were taken with their drones to the mating grounds in order to insure keeping pure imported Italian stock. These queens were brought back, laying June 10, and are being tested.

The records of the parent queens and the two daughters are as follows:

NEW LISBON

Date Examined	Queen D Imported			Queen P Unknown			Queen A Pdtr X Imp			Queen O Pdtr X Imp		
1923	Number brood	Remarks	Honey	Number brood	Remarks	Honey	Number brood	Remarks	Honey	Number brood	Remarks	Honey
3/23	3	....	....	2	....	....	.....	....	....	.....	....	....
4/1	2	....	....	4	....	....	.....	....	....	.....	....	....
4/7	3	....	....	6	....	....	.....	....	....	.....	....	....
5/4	5	....	....	6	....	....	.....	....	....	...	....	....
5/11	8	....	....	4	....	....	.....	....	....	.....	....	....
5/17	9	....	....	12	....	....	.....	....	....	.....	....	....
5/24	10	....	....	11	....	....	.....	....	....	.....	....	....
5/31	11	....	....	13	....	....	.....	....	....	.....	....	....
6/6	12	....	....	10	....	....	.....	....	....	.....	....	....
6/14	11	....	....	8	....	....	.....	....	....	....	....	....
6/19	8	....	....	8	....	....	.....	....	....	.....	....	....
7/3	8	....	....	8	....	....	.....	....	....	.....	....	....

NEW LISBON—Continued

Date Examined	Queen D Imported			Queen P Unknown			Queen A Pdtr X Imp			Queen O Pdtr X Imp		
1923	Number brood	Remarks	Honey	Number brood	Remarks	Honey	Number brood	Remarks	Honey	Number brood	Remarks	Honey
7/10	8	....	....	4	....	....	.....	....	....	.....	....	....
7/17	7	....	....	7	....	....	.....	....	....	.....	....	....
7/23	7	....	....	7	....	....	.....	....	....	.....	....	....
8/3	7	....	....	7	....	....	.....	....	....	.....	....	....
8/15	6	....	....	7	1 cell E.fb.	....	7	5 per cent E.fb.	....	3	2 per cent E.fb.	....
8/28	6	....	....	7	....	....	7	Gave Queen ...	....	3	Gave Q-0	....
9/6	6	....	....	7	....	....	6	Gave Queen ...	....	3	2 per cent E.fb.	....
9/13	6	....	....	7	....	....	6	1 per cent E.fb.	....	5	2 per cent E.fb.	....
9/20	5	....	....	6	....	....	5	....	....	4	2 per cent E.fb.	....
9/27	5	trace E.fb.......	60	5	40 lbs. honey ..	70	4	....	....	3	2 per cent E.fb.	....
10/5	5	35 lbs. honey....	....	4	3 cells E.fb. ...	....	4	25 lbs. honey...	....	3	30 lbs. honey ..	....

NEW LISBON—Continued

Date Examined	Queen D Imported			Queen P Unknown			Queen A Pdtr X Imp			Queen O Pdtr X Imp		
1924	Number brood	Remarks	Honey	Number brood	Remarks	Honey	Number brood	Remarks	Honey	Number brood	Remarks	Honey
4/2	2	....	....	2	....	....	3	....	....	2	....	....
4/9	3	....	....	3	....	....	3	....	....	2	....	....
4/21	2	....	....	4	....	....	3	1 per cent E.fb.	....	4	....	....
5/5	5	Took Q 2 brood..	....	4	....	....	5	....	....	5	....	....
5/6	3	....	....	5	....	....	9	Moved Q 2 b..	....	5	....	....
5/28	3	....	....	6	....	....	2	....	....	5	....	....
6/3	4	....	....	6	Moved Q 2 b...	....	2	....	....	4	....	....
6/10	4	....	....	2	....	....	3	....	....	4	Supersedure ...	....
6/17	5	....	....	3	....	....	4	....	....	4	....	....
6/24	5	....	....	6	....	....	5	....	....	3	Queen moved...	....

Honey under remarks for food.
E.fb.—European foul brood.
Q—Queen.
b—brood.

High Production Strains

The breeding of high producing strain of honeybees has been retarded by a desire to test thoroughly the stocks on hand. In this connection records have been kept on all the colonies in the Lebanon for brood rearing, production, temper and tendency toward swarming. These records follow; the letter designating the hive, the name, the kind of queen. In connection with these data a study is going on as to the possibility of correlating high production with a physical factor, the length of tongue. Some of the reasons making the knowledge of value are detailed in the 1922-23 report of the entomologist. As related in the report, some data, published by Merrill[8] in 1922, made it

TABLE 26

Mean Length of Tongues of Bees and Production Per Colony

Hive	Average length of tongue (micrometer units)	Honey production
		pounds
A	39.48	211
C	38.88	74
D	38.33	126
E	38.36	146
F	38.65	177.5
G	37.56	138
H	38.7	116
J	39.48	93
K	38.91	117
L	38.73	0
M	38.76	80
N	39.31	123
O	40.66	181
P	.....	.....
Q	39.21	69
R	.....	.....
S	.....	.....

appear that there is a marked correlation between the length of the tongue in the honeybee and honey-gathering ability. Before adopting the method for picking breeding stock it was decided to measure the tongues of bees from hives with a known yield of honey. The work done last year was preparatory to this year's work on the same subject. Investigation having shown that 40 bees from a hive were sufficient number to give a measure of the mean length of tongue of the bees in a colony, it was decided to use 60 bees to reduce the error.

[8] Merrill, J. H. 1922. Journ. Econ. Ent., v. 15, No. 2.

The bees were killed with carbon bisulfide, preserved in alcohol until the winter, then beheaded and the heads soaked in 2 per cent sodium hydroxide 24 hours and measured with an eye piece micrometer. Table 26 gives the mean length of tongue for 60 bees from each colony and the production per colony. One micrometer unit=0.086 mm.

An inspection of this table reveals at once that there is a very small correlation between the length of tongue and the honey production in the colonies studied.

Records of the tests in the high production yard follow:

LEBANON

Date Examined	Queen A Spicer			Queen B Western Bee Farms			Queen C Western Bee Farms			Queen D Spicer			Queen E Davis		
1923	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
3/14	....	4 frame cluster.	....	....	4-frame cluster	....	....	4-frame cluster	....	....	4-frame cluster	....	....	2-frame cluster	....
4/2	....	Fed 10 lbs. 1:1 sirup	....	....	Fed 10 lbs. 1:1 sirup	....	....	Fed 10 lbs. 1:1 sirup	....	....	Fed 10 lbs. 1:1 sirup	....	....	Fed 10 lbs. 1:1 sirup	....
4/8	4	Fed 10 lbs. 1:1 sirup	...	2	....	....	3	....	....	3	....	....	2	....	....
4/12	5	....	....	2	Fed 10 lbs. 1:1 sirup	....	3	Fed 10 lbs. 1:1 sirup	....	4	Fed 10 lbs. 1:1 sirup	....	3	Fed	....
5/2	7	....	....	2	....	....	3	....	....	4	....	....	3	Took 1 brood.	....
5/8	8	....	....	3	....	....	3	....	....	4	....	....	7	Cut cells	....
5/15	10	....	....	5	Cut cell	....	5	....	....	5	....	....	7	....	....
5/22	10	....	....	5	Gave 2 brood.	....	5	....	....	4	Gave 2 brood.	....	7	Took 2 brood.	....
5 28	12	....	....	7	....	....	7	....	....	7	....	....	7	Shook	....
6/5	12	....	....	6	....	....	7	....	....	7	Shook	....	10	....	....
6/11	13	....	....	7	....	....	8	....	....	12	....	....	11	....	....
6/18	10	....	....	7	....	....	8	....	....	12	....	....	10	....	....

Date Examined	Queen A Spicer			Queen B Western Bee Farms			Queen C Western Bee Farms			Queen D Spicer			Queen E Davis		
1923	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
6/25	10	....	....	6	....	....	8	....	....	10	....	....	10	....	....
6/2	10	....	....	5	....	....	7	....	....	9	....	....	9	....	....
7/9	9	....	....	4	Queen feeble..	....	3	Superseded ..	....	7	....	....	9	....	....
7/16	10	....	....	4	Gave W. B.F.Q.	....	....	Gave W. B.F.Q.	....	7	....	....	8	....	....
7/24	10	....	....	2	....	....	2	....	....	7	....	....	7	....	....
8/2	10	....	112	2	....	42	3	....	50	7	....	77	8	....	108
8/13	10	....	....	3	....	....	5	....	....	8	....	....	8	....	....
8/24	9	....	....	6	....	....	8	....	....	9	....	....	9	....	....
9/5	9	....	....	6	....	....	8	....	....	9	....	....	8	....	....
9/14	9	....	....	7	....	....	8	....	....	9	....	....	8	....	....
9/21	8	....	....	6	....	....	7	....	....	8	....	....	8	....	....
10/2	8	....	99	....	Susp. Burned.	....	7	....	24	7	....	49	8	....	39
11/10	....	30 lbs. honey Fed 10 lbs. sirup	....	....	....	....	....	35 lbs. honey, 10 lbs. sugar	....	....	....	....	....	35 lbs. honey fed	....

LEBANON—Continued

Date Examined	Queen A Spicer			Queen B Western Bee Farms			Queen C Western Bee Farms			Queen D Spicer			Queen E Davis		
1924	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
3/18	2	....	....	....	....	....	2	....	....	2	....	....	2	....	....
4/14	5	....	...	....	Cut cells	....	5	....	....	4	....	....	4	....	....
4/23	6	....	....	....	....	....	....	....	....	4	....	....	4	....	....
4/28	6	....	....	....	....	....	6	....	....	4	....	....	4	....	....
5/3	7	....	....	....	....	....	7	....	....	6	....	....	4	....	....
5/10	10	....	...	....	....	....	10	....	....	7	....	....	6	....	....
5/17	14	....	....	....	....	....	12	....	....	9	Supersedure .	....	8	....	....
5/26	14	....	....	....	....	....	13	....	....	8	Virgin	....	7	....	....
6/2	12	Supersedure cells	...	....	....	....	12	....	....	6	Queen O.K...	....	8	....	....
6/11	12	Took Q + 2 brood	...	....	....	....	12	....	....	6	....	....	8	....	....
6/16	3	In new colony..	....	....	....	....	12	....	....	6	....	....	8	....	....
6/23	4	....	....	....	....	....	12	....	....	6	....	....	8	....	....

Fed in spring 10 lbs. 1:1 sugar sirup; in fall 10 lbs. sugar.

LEBANON—Continued

Date Examined	Queen F Root			Queen G Spicer			Queen H			Queen I Davis			Queen J Davis		
1923	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
3/14	....	3-frame cluster	....	....	2-frame cluster	....	....	4-frame cluster	....	....	3-frame cluster	....	....	3-frame cluster	....
4/2	....	Fed	....	....	Fed	....	....	Fed	....	....	Fed	....	....	Fed	....
4/8	3	....	....	3	....	....	3	....	....	3	....	....	3	....	....
4/12	5	....	....	3	Fed	....	4	Fed	....	4	Fed	....	3	Fed	....
5/2	7	Cut cells	....	4	....	....	6	....	....	5	....	....	4	....	....
5/8	8	Cut cells	....	5	....	....	8	....	....	6	....	....	5	....	....
5/15	10	Cut cells	....	7	....	....	8	....	....	8	Cut cells	....	5	Gave 2 brood	....
5/22	10	....	....	7	....	....	8	....	....	9	....	....	5	....	....
5/28	12	....	....	8	....	....	9	....	....	8	....	....	6	....	....
6/5	12	Shook	....	8	Shook	....	11	Shook	....	9	Shook	....	7	....	....
6/11	10	....	....	7	Q gone	....	13	Took 3 brood	....	13	....	....	9	....	....
6/18	10	....	....	6	Cells	....	111	....	....	11	....	....	11	....	....

LEBANON—Continued

Date Examined	Queen F Root			Queen G Spicer			Queen II			Queen I Davis			Queen J Davis		
1923	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
6/25	10	....	....	5	Virgin	....	10	....	....	11	....	....	11	....	....
7/2	10	....	....	2	....	....	10	....	....	9	....	....	10	....	....
7/9	10	....	....	5	....	....	9	....	....	8	....	....	8	....	....
7/16	10	....	....	6	....	....	9	....	....	8	....	....	8	....	....
7/24	10	....	....	8	Mismate	....	9	....	....	7	....	....	7	....	....
8/2	9	....	1055	8	....	104	9	....	....	7	....	112	7	....	44
8/13	10	....	....	9	....	....	10	....	....	8	....	....	8	....	....
8/24	9	....	....	10	....	....	10	....	....	9	....	....	9	....	....
9/5	9	....	....	8	....	....	9	....	....	9	....	....	9	....	....
9/14	9	....	....	3	....	....	9	....	....	8	....	....	8	....	....
9/21	8	....	....	2	....	....	8	....	....	7	....	....	8	....	....
10/26	6	40 lbs. honey....	72	5	30 lbs. honey.	34	6	40 lbs. honey.	....	6	30 lbs. honey.	27	6	30 lbs. honey.	49
11/10	....	Fed	....	....	Fed	....	....	Fed	....	....	Fed	....	....	Fed	....

LEBANON—Continued

Date Examined	Queen F Root			Queen G Spicer			Queen H			Queen I Davis			Queen J Davis		
1924	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
3/8	2	....	....	2	....	...	2	....	...	1	....	....	3	....	...
4/14	3	....	....	4	....	...	4	....	...	3	....	..	3	....	...
4/23	5	....	....	4	....	...	5	....	...	4	....	...	6	....	....
4/28	5	....	....	5	....	...	5	....	....	5	....	...	7	....	....
5/3	6	....	....	6	....	...	6	....	...	6	....	....	7	....	...
5/10	8	....	...	8	....	..	8	....	...	8	....	....	9	....	..
5/17	13	....	....	9	....	...	9	....	...	10	....	...	12	....	...
5/26	12	....	....	12	....	...	9	....	...	12	....	....	11	....	...
6/2	12	....	...	10	....	...	9	....	...	9	Superseded ..	...	11	....	....
6/11	11	Took 2 brood + queen	....	9	....	...	10	....	...	8	....	....	11	....	....
6/16	11	....	...	9	....	..	11	Shook	....	11	Q O.K.	..	11	....	....
6/23	3	....	...	9	....	....	11	....	...	7	....	....	11	....	..

Fed in spring 10 lbs. 1:1 sugar sirup; in fall 10 lbs. sugar.

LEBANON—Continued

Date Examined	Queen K Spicer			Queen L Root			Queen M Cutts			Queen N Root			Queen O Root		
1923	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
3/14	....	4-frame cluster	....	....	3-frame cluster	....	....	3-frame cluster	....	....	2-frame cluster	....	....	3-frame cluster	....
4/2	....	Fed	....	....	Fed	....	....	Fed	....	....	Fed	....	....	Fed	....
4/8	3	....	....	3	....	....	2	....	....	3	....	....	3	....	....
4/12	4	Fed	....	3	Fed	....	2	Fed	....	4	Fed	....	4	Fed	....
5/2	5	....	....	5	Took 1 brood	....	1	Virgin	....	7	....	....	6	....	....
5/8	6	....	....	7	Took 1 brood	....	3	....	....	8	....	....	7	Cut cells	....
5/15	8	....	....	7	....	....	6	....	....	8	....	....	8	....	....
5/22	8	....	....	8	....	....	4	....	....	8	Took 2 brood	....	9	....	....
5/28	8	....	....	8	....	....	2	....	....	7	....	....	10	....	....
6/5	11	....	....	8	Shook	....	7	....	....	10	....	....	11	Shook	....
6/11	14	....	....	9	Moved	....	7	Moved	....	12	....	....	12	....	....
6/18	13	....	....	9	....	....	9	....	....	8	....	....	11	....	....

LEBANON—Continued

Date Examined	Queen K Spicer			Queen L Root			Queen M Cutts			Queen N Root			Queen O Root		
1923	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
6/25	10			8			7			9			10		
7/2	10			8			7			8			8		
7/9	10			8			7			6			7		
7/16	10			8			7			6			7		
7/24	9			8	Took 2 brood		7			6			7		
8/2	9		101	8		63	7			6		103	7		105
8/13	8			8			7			7			7		
8/24	9			8			8	Q gone		7			8		
9/2	9			8			8	Gave Davis Q		8			8		
9/14	8			8			2			7			7		
9/21	8			9			3			6			6		
10/2	8	30 lbs. honey	16	6		42	6	35 lbs. honey	80	2	30 lbs. honey	20	5	30 lbs. honey	76
11/10		Fed						Fed			Fed			Fed	

LEBANON—Continued

Date Examined	Queen K Spicer			Queen L Root			Queen M Cutts			Queen N Root			Queen O Root		
1924	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
3/18	2			2			2			2			2		
4/14	3			5			3			5			4		
4/24	3			5			3			6			5		
4/28	4			5			4			7	Cells		6		
5/3	5			6			5			10	Took Queen + 3 brood		6		
5/10	8			8			7			3			10		
5/17	10			11	Took Q + 2 brood		11			4			11		
5/26	10			3			9			5			12		
6/2	8	Supersedure		5			9			6			10		
6/11	6			8			9			7			10		
6/16	5			9			9			8			10		
6/23	3	Q O.K.		10			9			9			10		

Fed in spring 10 lbs. 1:1 sugar sirup; in fall 10 lbs. sugar

LEBANON—Continued

Date Examined	Queen P Cutts			Queen Q Davis			Queen R Cutts			Queen S Dtr Spicer			Queen T Dtr Davis		
1923	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
3/14	...	2-frame cluster	...	...	2-frame cluster	...	...	2-frame cluster	...	...	...	...	...	...	...
4/2	...	Fed	...	...	Fed	...	...	Fed	...	...	...	...	...	...	...
4/8	2	Fed	...	3	...	...	2	...	...	...	...	...	...	...	...
4/12	3	...	...	3	Fed	...	3	Fed	...	...	...	...	...	...	...
5/2	3	...	...	4	...	...	5	...	...	...	...	...	...	...	...
5/8	5	...	...	5	...	...	7	...	...	...	...	...	...	...	...
5/15	6	...	...	6	...	...	7	...	...	...	...	...	...	...	...
5/22	6	...	...	6	...	...	7	...	...	...	...	...	...	...	...
5/28	7	...	...	6	...	...	9	...	...	...	...	...	...	...	...
6/5	8	Shook	...	9	...	...	9	Shook	...	...	...	...	...	...	...
6/11	9	...	...	11	...	...	11	...	...	...	...	...	...	...	...
6/18	9	...	...	10	...	...	11	...	...	...	...	...	...	...	...

LEBANON—Continued

Date Examined	Queen P Cutts			Queen Q Davis			Queen R Cutts			Queen S Dtr Spicer			Queen T Dtr Davis		
1923	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
6/25	9			9			11			2					
7/2	8			8			10			2			2		
7/9	8			4	Supersedure		9			5			3		
7/16	9			2	Gave Davis Q		9			6			4		
7/24	9			6			9			8			6		
8/2	9		54	6		45	8		107	8			6		
8/13	8			7			8			8			6		
8/24	8	Gave Davis Q.		7			9			8			6		
9/5	2			8			9	Gave Davis Q		8			6		
9/14	3			7			2			7			6		
9/21	5			6			2			7			6		
10/2	5	35 lbs. honey	28	6	30 lbs. honey	24	4	30 lbs. honey	68	6	40 lbs. honey		6	35 lbs. honey	
11/10		Fed			Fed		5	Fed		5	Fed		6	Fed	

LEBANON—Continued

Date Examined	Queen P Cutts			Queen Q Davis			Queen R Cutts			Queen S Dtr Spicer			Queen T Dtr Davis		
1924	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey	No. frame brood	Remarks	Honey
3/18	....	Queenless	....	....	....	....	....	....	....	....	....	....	....	....	....
4/14	....	United with I..	....	2	....	....	....	....	....	2	....	....	2	....	....
4/24	....	....	....	4	....	....	....	....	....	5	....	....	5	....	....
4/28	....	....	....	4	....	....	....	....	....	6	....	....	5	....	....
5/3	....	....	....	5	....	....	....	....	....	6	....	....	4	....	....
5/10	....	....	....	6	....	....	....	....	....	6	....	....	5	....	....
5/17	....	....	....	9	....	....	....	....	....	10	Took Q + 2 brood	....	8	....	....
5/26	....	....	....	10	....	....	....	....	....	2	....	....	10	....	....
6/2	....	....	....	10	....	....	....	....	....	3	....	....	10	....	....
6/11	....	....	....	11	....	....	....	....	....	4	....	....	11	....	....
6/16	....	....	....	11	....	....	....	....	....	4	....	....	12	....	....
6/23	....	....	....	11	....	....	....	....	....	5	....	....	10	....	....
....	....	....	....	....	....	....	....	....	....	6	....	....	10	....	....

REPORT OF MOSQUITO WORK

THOMAS J. HEADLEE, PH.D.

Introduction

The work in this project may be divided into two parts—investigation and practical control.

Investigations

The biological and chemical phases of the investigation were carried on by Dr. Rudolfs, whose statement of results follows. The question of the underlying reason for the common observation that mosquito breeding is absent, or practically so, from cedar swamp waters and abandoned clay ponds was given consideration, but the data accumulated have not been sufficient to permit the drawing of firm conclusions. The important problem of mosquito repellants was studied and sufficient data obtained to permit the drawing of some real conclusions. This material is, therefore, inserted in this report. In the course of this study peculiar reactions to certain repellents were noted that seemed to constitute clear instances of autotomy—violent muscular action, resulting in ruptures of the tissue and the breaking off of appendages. The bearing of these results upon this practical problem of mosquito control is not such as to justify the inclusion of the data in this report.

Studies of Mosquito Repellents

WILLEM RUDOLFS, PH.D.

A knowledge of the effect of repulsive agents upon the actions of mosquitoes is of great economic importance. For a study of repellents a large number of essential oils, heavy oils, chemicals and mixtures were tried under 3 different conditions, namely, with cold and warm materials on confined mosquitoes and cold materials placed on the skin in the open. In order to find out whether or not one or more substances found in the different materials, credited with comparatively good results for the protection of the user, were responsible for the protection, a number of pure substances were tried also. The experiments were made with *Aedes sollicitans, A. cantator* and *Culex pipiens*. All experiments were repeated several times. A summary of part of the results is presented in table 27.

TABLE 27

Repellent Action of Various Volatile Substances to Mosquitoes

Material	Reaction[1]	Alight and bite on hands after:	
		alight	bite
		min.	*min.*
Bergamot	Irritating	10–15	20–30
Lime	Extremely irritating	75	90
Linalyl acetate	Extremely irritating	45	50–60
Rose geranium	Irritating	75	90
Lavender	Somewhat irritating	15	30
Lemon	Very irritating	10	15
Bitter Orange	Extremely irritating	45	60
Citronella	Strongly irritating	20	45–60
Cinnamon	Irritating	40	60
Bitter almond	Irritating	60	75
Juniper berries	Extremely irritating	30	60
Pine needle	Irritating	45	60
Peppermint	Slightly irritating	50	60[2]
Rosemary	Somewhat irritating	30	45
Spearmint	Irritating	30	45
Pennyroyal	Irritating	60	90
Menthol	Irritating	5	8
Etherial camphor	Irritating	30	45
Sassafras	Very irritating	20	30
Clove	Irritating	60	100–120
Anise seed	Irritating	10	20
Laurel	Irritating	30	45
Wintergreen	Irritating	30	45
Artificial wintergreen	Irritating	30	45
Spruce	Irritating	45	60
Hemlock	Very Irritating	60	75
Pine pumilionis	Irritating	60	75
Turpentine	Irritating	15–25	15–25
Ginger	Irritating	20	30
Nutmeg	Irritating	40	60
Thyme	Somewhat irritating	45	75
Thymol (in water)	Very slightly irritating	0	0
Eucalyptus	Very irritating	30	45–60
Eucalyptol	Very irritating	30	45–60
Menhaden	Stimulated	0	0
Fusel	Irritating	3	10
Cedar	None	0	0
Crude petroleum	Somewhat irritating	30	30
Fuel	Strongly irritating	5	10–15
Phenol	Irritating	10–15	25–30
Kerosene	Irritating	5	10
Kerosol	Somewhat irritating	0	0
Creolin	Not irritating	3	8–10
Pyrethrum (mixed with vaseline)	Irritating	75	100–120
Vaseline	Slightly irritating	5	8–12

[1]Reaction of confined mosquitoes caused by cold oil.
[2]Oil burns skin.

There are two possibilities affording protection against bites—(a) obscuring of attractive agents by certain materials; possibly volatile substances or materials which prevent the attracting substances being noticed by the insect, and (b) direct repulsion by the material applied to the skin; volatile materials which are disagreeable or harmful to the insect. The second agent seems to be, at the present state of our knowledge, of greater economic importance.

From the table it can be seen that the oils differ greatly in their value as measured by the time affording protection. It is interesting to note that not all substances which seem to have the greatest influence on the physical condition of the mosquitoes are the best protecting materials. Some oils and pure materials, which cause autotomy in mosquitoes, protect the user a shorter time than substances causing nervous convulsions, or which have no apparent influence on the physical condition of the insects. Taking the time elapsed between application of the material and the alighting of mosquitoes as an index of protection, it is clear from the table that but few of the substances tried afford protection for one hour or longer, and none give absolute protection. The time of protection is materially influenced by the volatility of the substance, and the most promising materials were mixed with talcum powder, corn starch, face powder mixture, vaseline, etc. In all cases the time of protection was materially extended.

Ditch-Cleaning Machinery

In cooperation with the Atlantic County Mosquito Commission a ditch-cleaning machine was designed, financed, and built and operated during the months of May and June. The record of its operation during the month of May is particularly interesting and submitted herewith.

Total footage cleaned 10 by 24 inches			157,476 feet
Labor		$242.11	
Gasoline 185 gal. @ 19½c.		36.08	
Oil 13 gal. @ 38½c.		5.01	
Repairs and Renewals—			
Seashore Mach. Wks.	$86.84		
Latimer & Company	31.88		
		118.72	
Transporation of Labor		24.00	
			$425.92
Estimated investment $3,000.00.			
Depreciation @ 33⅓% for 1 mo.		$83.33	
Interest on investment for 1 mo.		15.00	
			98.33
Total cost and upkeep for May			$524.25

Cost of cleaning per foot $.0033.

The above record shows that the cost of ditch cleaning in ditches 10 inches wide, and, approximately, 30 inches deep, is almost exactly one-third of a cent per linear foot. When we compare this performance with the known average cost of similar ditch cleaning at 2 cents per linear foot by hand, and when we realize that the thoroughness of cleaning obtained by the use of this machine cannot be duplicated by hand, we see at once the meaning of this new piece of apparatus.

Mr. Fred A. Reiley, superintendent of the Atlantic County Mosquito Commission, was the designer and builder of this machine. The state contributed $2,200 and such advice and suggestions as seemed practical.

Already the machine has made such a showing that the Atlantic County Mosquito Commission has authorized the building of another machine, and other county commissions are considering similar action.

Ditch-Cutting Machinery

The test of the ditch-cutting unit was completed early in the fiscal year 1923-1924, but the funds remaining were not sufficient to permit the building of the necessary carrying tractor. A 5-ton Holt tractor, without the tracks and the track frames, was purchased as a power plant for the proposed ditch-cutting machine. The purchase of additional materials necessary to complete the tractor and the building of this tractor will have to be done during the fiscal year beginning July 1, 1924.

It is, of course, anticipated that the cost of ditching with this machine will not exceed one-half of a cent per linear foot, and when that anticipation of performance is compared with the present cost of ditching, which is about 2 cents per linear foot, it becomes clear that such a machine should offer a tremendous contribution toward rendering the finishing of the salt marsh drainage practicable.

Practical Work

WILBUR M. WALDEN

Salt Marsh Drainage

In accordance with the experiment station's usual custom of assisting in the salt marsh drainage in those counties where it is deemed the work is most needed, two contracts, amounting to $4,500, were placed on May 31, 1923; one in Lacey and Ocean townships in Ocean County for 70,000 linear feet of 10 by 30-inch ditching, and the other in Upper township in Cape May County for 137,600 linear feet or more of 10 by 30-inch ditching.

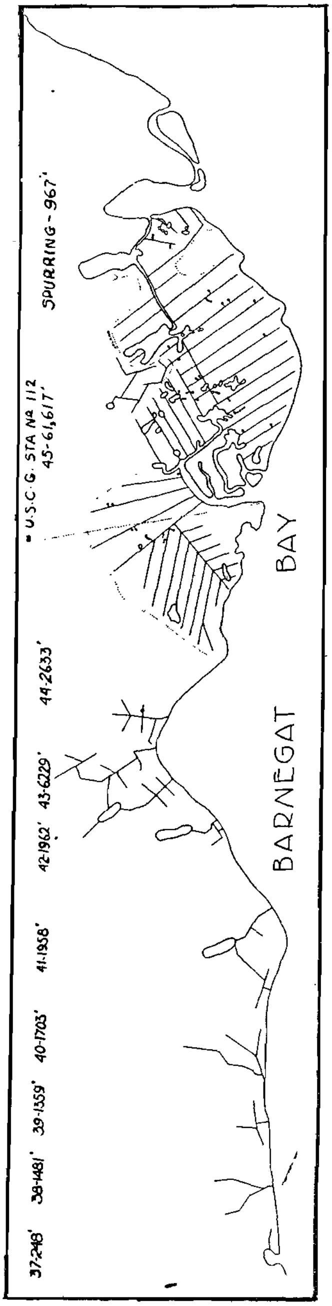


FIG. 2. Sketch of ditching on Island Beach, Ocean County.

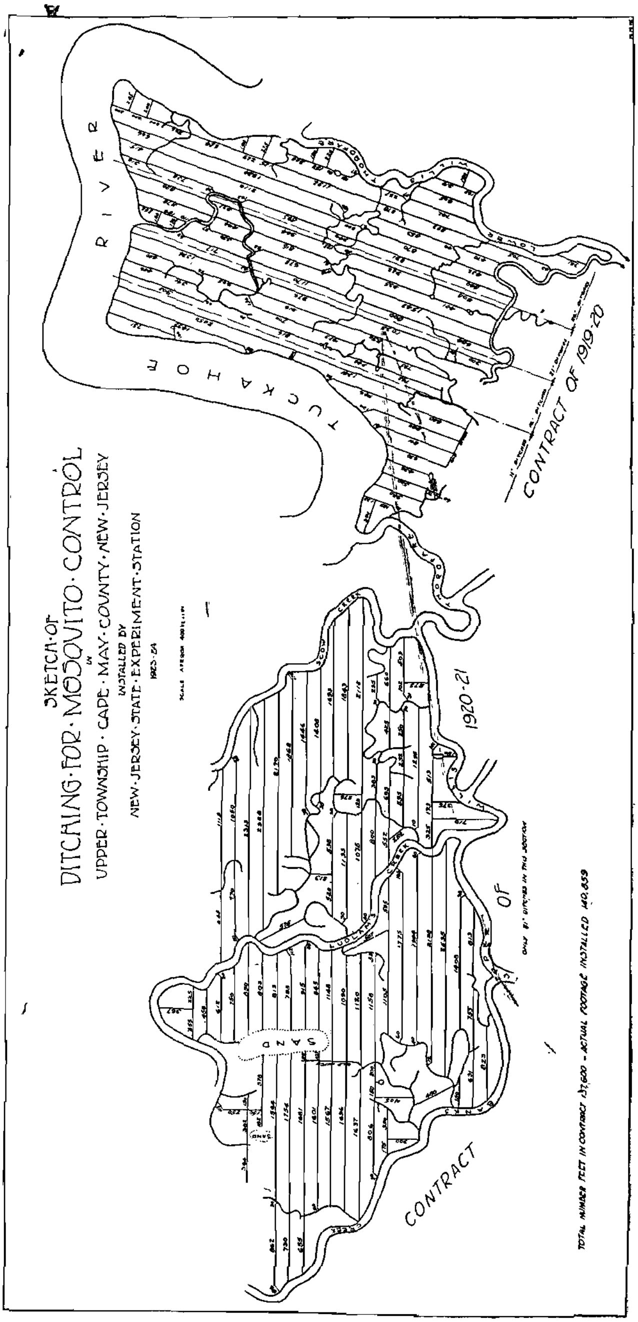


FIG. 3. Sketch of ditching in Upper Township, Cape May County.

Mr. Paul Cramer, of Manahawkin, was awarded the contract in Ocean County at a price of $.024 per foot, and Mr. Harold I. Eaton, of Atlantic City, was awarded the Cape May County contract at a price of $.01875 per foot.

Actual digging in Ocean County was begun on August 24 at the point where the previous contract left off, and the work was completed on November 4 with a total of 80,157 feet dug, an over-run of 157 feet above the footage called for by the contract.

A lay-out of the ditches is shown in figure 2.

The contract in Upper township, Cape May County, was technically started on July 7, but, due to the press of other contract work in Ocean County, the contractor discontinued digging until September 20. The entire contract for 137,000 feet of ditching was cut by November 26. A sketch of the ditching system is shown in figure 3.

As the work of salt marsh drainage has gone forward, certain instances have been observed in which the ditch banks became soft, particularly when the marsh bordered the outlets of fresh-water streams. As this area seemed to offer opportunity to obtain needed data, it was divided into four sections, and 11-inch, 16-inch, 21-inch and 26-inch ditches installed, respectively. Observation of this area should give us valuable data on the more or less mooted question of the effect of ditch depth on bank softening, alder growth and salt marsh herbaceous plants.

After an inspection of that portion of the contract area, bounded by the Tuckahoe river and Upper and Lower Willet's creeks, by Director Jacob G. Lipman, Dr. Thomas J. Headlee, executive officer in charge, and the writer, it was decided that this section was ideal for experimental work on the open salt marshes. Investigation had already demonstrated that there were no property owners for this section listed and no taxes had been paid on any portion of this area for years back. A map was therefore prepared and a description of existing conditions submitted to the office of the Attorney General for his consideration in the hope that title to this unclaimed land might be given by the state to the state experiment station for experimental purposes.

The map of the salt marsh previously referred to is shown in figure 4.

The sand dike built in Cape May County last year, and which was described in our 1922-1923 report, has been a decided success. To quote from last year's report: "Twelve-foot piling staggered at 2-foot centers and hydraulically sunk 7 feet in the sand were placed along the proposed line of dike and brushed with ordinary brush. The action of the sea has already washed in great quantities of sand which are collected by the brush and piles and deposited." The sand continues to be deposited and a perfect dike is the result.

The committee, appointed by the associated executives to study drainage on the diked salt marsh meadows with a view to obtaining standards in the control work, reported the following findings:

(1) In diked grass meadows where "rotten holes" occur (with depths of as much as 15 inches), it is advisable to maintain the level of the water in the ditches at least 18 inches below the average surface of the meadow. This is to prevent breeding on the surface of the meadows and in the "rotten holes" and is not concerned with breeding in the ditches.

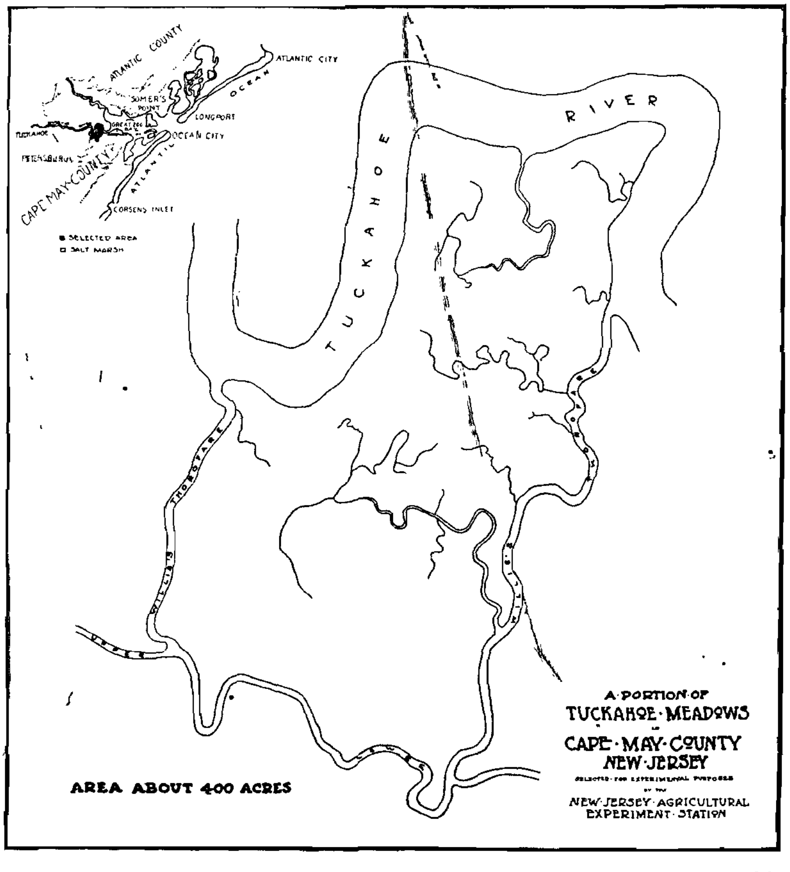


FIG. 4. Map of "Island Meadows" along Tuckahoe River, Upper Township, Cape May County.

In meadows where "rotten holes" do not occur, it is advisable to maintain the level of the water in the ditches at least 12 inches below the average surface of the meadows in order to prevent surface breeding.

(2) The meadow area adjoining the upland has been found difficult to drain for two reasons: First, because its level is lower than that of any other portion of the meadow, being farthest removed from the building-up influence of the tides; and second, because of the water draining from the upland. Because of this difficult drainage abundant mosquito breeding often occurs in these areas.

TABLE 28

Salt-marsh Drainage in New Jersey Measured in Ditches 10 Inches Wide and 30 Inches Deep—Feb., 1924

Year	Hudson County		Bergen County		Essex County		Union County		Middlesex County		Monmouth County	
	State Exp. Sta.	Co. Com.	State Exp. Sta.	Co. Com.	State Exp. Sta.	Co. Com.	State Exp. Sta.	Co. Com.	State Exp. Sta.	Co. Com.	State Exp. Sta.	Co. Com.
	feet	*feet*	*feet*	*feet*	*feet*	*feet*	*feet*	*feet*	*feet*	*feet*	*feet*	*feet*
1902–1912	171,350	113,500	...	...	217,800	618,000	707,812	372,112	505,800	...	553,700	237,500
1913	...	100,000	...	...	...	350,000	...	25,000	30,000	...	...	...
1914	...	126,000	...	...	...	...	25,000	37,385	...	52,800	...	245,872
1915	...	150,000	346,282	155,000	...	30,098	...	129,777	...	116,564	...	25,000
1916	...	140,000	...	150,000	...	69,057	...	13,814	...	186,100	...	136,000
1917	...	109,943	...	...	...	30,000	...	57,941	...	35,051	...	46,476
1918	...	9,665	...	22,500	...	10,095	...	1,500	...	45,051	...	7,000
1919	...	145,488	...	58,000	...	39,923	...	8,000	...	98,873	...	22,576
1920	...	50,348	...	750,164	...	21,000	...	4,000	...	61,200	...	63,800
1921	...	40,000	...	122,000	...	17,810	...	20,000	...	56,066	...	49,755
1922	...	70,000	...	41,000	...	14,400	...	47,000	...	165,465	...	13,910
1923	...	72,037	...	8,750	...	28,571	...	36,560	...	178,110	...	23,570
Totals	171,350	1,126,981	346,282	1,307,414	217,800	1,228,954	732,812	753,089	535,800	994,280	553,700	871,459
Grand Totals	1,298,331		1,653,696		1,446,754		1,485,901		1,530,080		1,425,159	

TABLE 28—Continued

Salt-marsh Drainage in New Jersey Measured in Ditches 10 Inches Wide and 30 Inches Deep—Feb., 1924

Year	Ocean County		Atlantic County		Cape May County		Cumberland County		Yearly Totals
	State Exp. Sta.	Co. Com.	State Exp. Sta.	Co. Com.	State Exp. Sta.	Co. Com.	State Exp. Sta.	Co. Com.	
	feet	*feet*	*feet*	*feet*	*feet*	*feet*	*feet*	*feet*	*feet*
1902–1912	1,954,380	15,000	....	....	....	....	....	....	6,096,954
1913	399,842	....	260,000	404,365	....	....	630,000	....	1,569,207
1914	....	....	271,601	828,367	....	....	....	....	1,587,025
1915	....	30,000	....	1,325,100	209,634	....	....	....	2,517,455
1916	....	339,520	....	1,391,912	....	132,239	....	....	2,558,642
1917	119,285	538,277	....	323,907	101,987	161,479	....	....	1,524,346
1918	137,931	360,097	....	305,003	137,931	161,479	....	....	1,198,252
1919	90,074	336,946	....	311,331	140,000	116,980	....	....	1,367,191
1920	90,909	328,219	....	406,455	159,091	117,451	....	....	2,052,637
1921	....	180,000	....	540,000	....	116,400	....	....	1,142,031
1922	80,000	368,692	....	680,060	137,600	100,000	....	....	1,718,127
1923	....	487,582	....	397,074	....	212,500	....	....	....
Totals	2,872,421	2,984,333	531,601	6,913,574	886,243	1,118,528	630,000	....	....
Grand Totals	5,856,754		7,445,175		2,004,771		630,000		24,776,621

To improve the drainage of these areas a marginal ditch should be used, placed in the meadow parallel to the edge of the upland, and at a distance of 100 feet or less from the upland, this distance varying with soil conditions.

(3) In view of the great increase of mosquito breeding as a result of sewage pollution, it is recommended that, as far as possible, sewage water and the clean water on the meadows be kept entirely apart and carried off through separate systems of drainage.

(4) To secure proper drainage, the length of a 10-inch ditch should not be more than 1,000 feet from a proper outlet; similarly, a 20-inch ditch should not exceed a length of 2,500 feet.

(5) Our experience with the existing drainage systems in the 4 counties indicates that it is impractical to destroy ditch breeding by opening a series of tide gates to get circulation of water.

(6) We believe it is desirable to keep the tide gates open during the non-breeding season, so as to maintain the salt content of the meadow and thus keep up the plant growth, which will tend to maintain the existing level of the meadow and prevent shrinkage. There is also less danger of the area's catching fire and burning if the meadow peat is kept saturated during the non-breeding season. We believe, however, that gates should not be kept open on such marshes as have already shrunk to such a point that they will not be built up again by the growth of salt marsh vegetation. It is obviously impractical to open the gates at all on diked meadows which have been converted into agricultural or industrial areas.

(7) Where tide gates are apt to jam open and serious results follow, we would suggest the advisability of using a tandem gate, that is, one gate placed behind the other. Such gates have been in satisfactory use in Nova Scotia for many years. The Hudson County Mosquito Extermination Commission has endorsed the building of a tandem gate at a point where jamming open would be disastrous because of the low level of the area protected.

(8) The Hudson County Mosquito Extermination Commission has drained 1,200 acres of low-lying marsh land by means of 2 pumps of the centrifugal type, one of 12-inch and one of 10-inch diameter, with a combined average capacity of 4,000 gallons per minute. During a 10-week period the pumps were operated 1,490 hours and removed 197,000,000 gallons of water. The cost of this work, including electric power, labor, lubrication, etc., was $2.65 per million gallons. The costs for the season of 1923 were as follows:

Power	$744.96
Labor	252.50
Lubrication, etc.	31.00
	$1,028.46

This amounts to less than $1.00 per acre controlled for the season. This is a low-lying area where tide gates cannot be used, as the surface of the meadow is, on the average, 1 foot below mean low tide. The cost per acre would probably be very much reduced if pumping were used in connection with tide gates.

The present method of mosquito control on diked salt marsh areas (except an area of 1,200 acres in Hudson County) is to drain the meadow surface to the ditches by gravity, assisted by tide gates, and to trust to fish and oiling to prevent the emergence of mosquitoes from the ditches.

We believe that more efficient control could be obtained if all the water were removed from the ditches at proper intervals of the time during the mosquito-breeding season.

To drain the ditches completely we believe that gravity drainage should be supplemented by pumps.

The experience of the Hudson County Commission leads us to believe that this supplementary pumping would be inexpensive when compared with the results that would be obtained by a complete removal of water from the salt marsh areas.

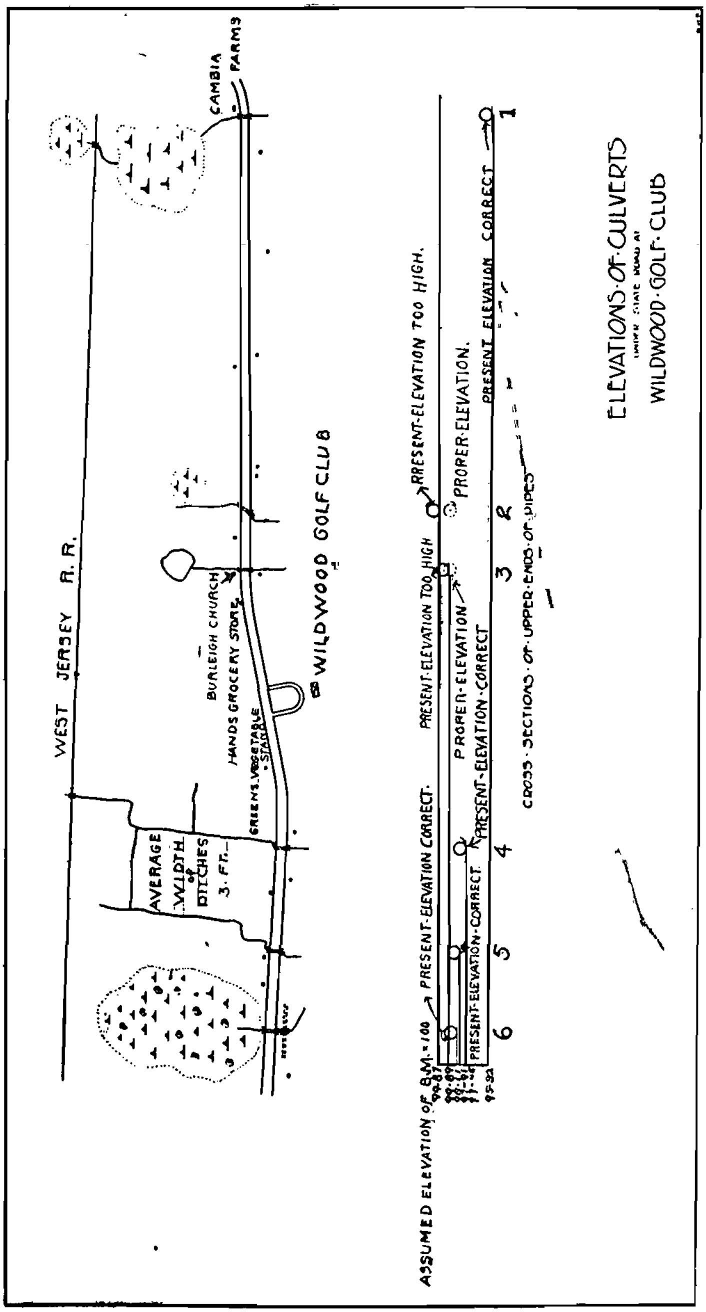
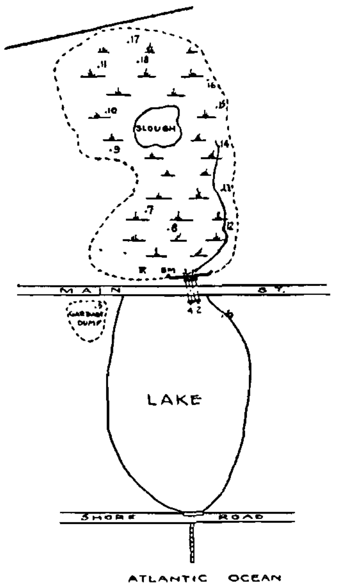


Fig. 5. Elevations of Culverts at Wildwood Golf Club.

Plans, Surveys and Inspections

Wildwood Golf Club Grounds

At the request of the Cape May County Mosquito Commission, in April, 1923, levels were taken on the culverts under the state road at the Wildwood golf course to determine to what extent the fresh water swamps located on the west side could be drained. An interview with the state highway engineer disclosed the fact that the highway commission would be willing to lower 1 of the 6 culverts, provided that a ditching system could be established connecting all of the swamps west of the road with it. It was found that the culvert directly south of the Wildwood club house is low enough to take the water from the one swamp directly south and the two swamps directly north of it. The culvert located at the Cambria Farms is low enough to take all of the water west of it, provided the present ditching system is cleaned out. It was impossible to take levels in the swamp furthermost south of the golf club, and it was suggested that the Cape May Commission establish a ditching system and connect with the culvert already installed. If it is found that the culvert is too high, a ditch connecting with the culvert just south of the Wildwood Golf Club could be cut.



PT.	ELEV.	DESCRIPTION
1	3 94	BOTTOM OF PIPE
2	3 95	do
3	3 94	do
4	5 04	do
5	6 07	BOTTOM OF HOLE IN DUMP
6	5 91	WATER SURFACE
7	5 84	POINT IN SWAMP
8	5 26	do
9	5 92	do
10	6.11	do
11	5.13	do
12	4 62	BOTTOM OF CREEK
13	5 51	POINT IN SWAMP
14	4 59	BOTTOM OF CREEK
15	5.50	POINT IN SWAMP
16	4 91	do
17	5.80	do
18	5 36	do
19	5 74	TOP OF GATE IN OUTLET
20	1 74	BOTTOM OF OUTLET PIPE

SKETCH
OF
SWAMP ON MAIN ST., SPRING LAKE, N.J
SHOWING
ELEVATIONS TAKEN FOR DRAINAGE

NO SCALE
ASSUMED ELEV OF B.M = 10 FT.

W.M.W.

FIG. 6. Elevations on Swamp, Main Street, Spring Lake.

Spring Lake

Mr. Harry V. VanNote, Chief Inspector of the Monmouth County Mosquito Commission, requested this department in October, 1923, to take elevations on the swamp which lies north of Main Street at Spring Lake. It was

found that the two pipe culverts under Main Street were sufficiently low to take the water from the lowest point in the swamp. However, the gate to the culvert under the Shore Road, which acts as the outlet to the lake between Main Street and the Shore Road is too high, and until this is lowered drainage of the swamp would be impossible.

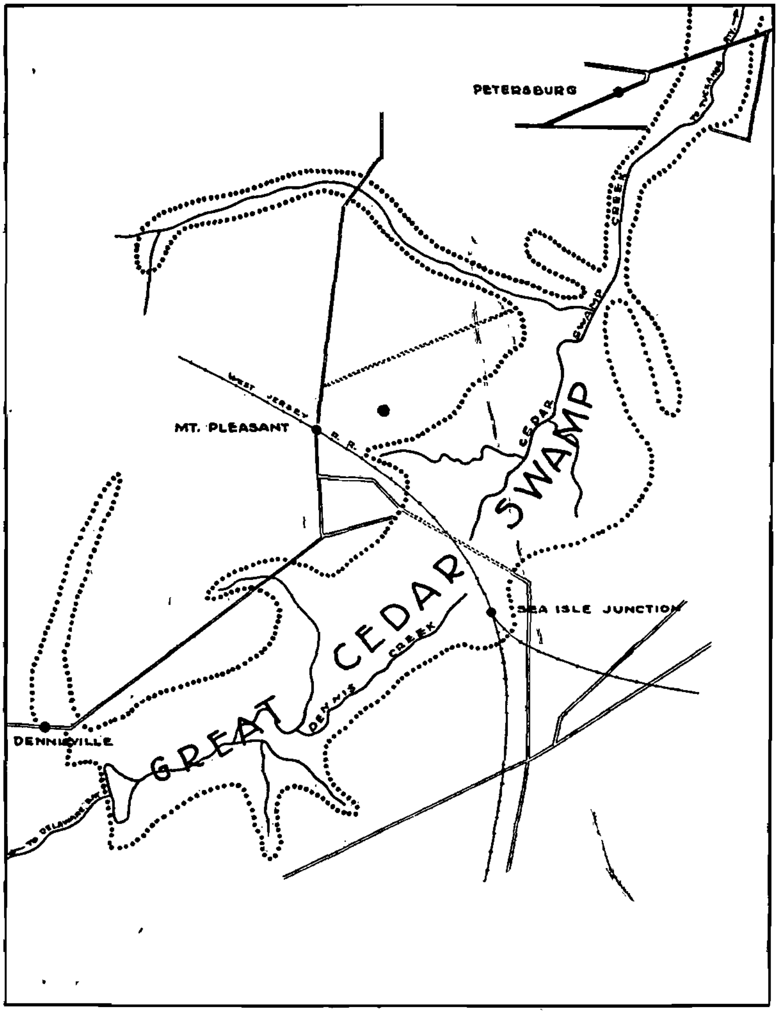


FIG. 7. Map of Great Cedar Swamp.

Great Cedar Swamp

In compliance with a request from the Cape May County Mosquito Extermination Commission for a mosquito survey of Great Cedar Swamp in that county, such survey was made by the writer and his assistant on October 6

and 7. Dr. Willem Rudolfs of the state experiment station accompanied us to examine both the water and soil for biological determinations.

Great Cedar Swamp extends from Dennisville northeast to Petersburg, a distance of about eight and one-half miles. Its width varies from a mile at the southwest end, where it joins the salt marsh, to a point about five miles towards Petersburg, where its width increases to a mile and a half. From this point northeast the width diminishes to less than a half mile at a point where the salt marshes of the Tuckahoe River meet it.

The point of the highest elevation lies midway between Sea Isle Junction and Mount Pleasant near the West Jersey railroad, which crosses the swamp and which divides it practically in half.

A short distance from Cedar Swamp Creek is a slight but perceptible slope covered with oak, maple, birch, huckleberry, laurel, briar, five-leaf and poison ivy. The creek is lined with cedar and some pine. Most of the pine in the slopes has been lumbered. On the edge of the creek, where cedar does not reach, cranberry, grasses and sphagnum are found with occasional patches of reeds. The leafy trees and huckleberry indicate that a good natural drainage exists on the straight slopes, while reeds and sphagnum, together with the cedar along the creek and tributaries, indicate poor drainage. Where reeds and sphagnum are found there is usually a very shallow undulation, causing a real swampy condition.

The region of Dennis Creek is slightly different from the regions of Cedar Swamp Creek in respect to elevations. The main creek seemed clearly defined, and, from indications present, seemed to overflow only occasionally with heavy rainfall in summer, but might be inundated during winter time. About ¼–⅓ mile from the main creek are rather steep banks running out from a somewhat higher, slightly-rolling upland. The cedar and pine reach about half way up the banks where the vegetation changes. Higher on the banks are found oaks, birch, pine, maple and ash with a fairly heavy undergrowth on the upland. In the midst of these cedar groves open patches are found where pine, alderberry, dogwood, two kinds of laurel, cranberries, huckleberries, poison ivy and five-leaf masses are present, and also some maple, blackberries, sassafras and holly. Cedar groves are cut up by small tributary streams. Cranberries, ferns and grass line the creek and its tributaries.

On October 6 the inspection covered Cedar Swamp Creek from the old dam at Petersburg to the head waters. At points samples of water were taken, a chemical analysis of which showed a rise in acidity. These conditions, of course, were anticipated. Evidence was found that the tide rises and falls in the creek to within a mile of the head. No evidence was found, however, that water collects in any part of the woods on either side of the creek which is not affected by the tide.

The main soil is composed of a gravelly sand with an occasional spot where we found a 2 or 3-inch layer of peaty soil. Such conditions are not conducive to mosquito breeding. The inspection was made during continued dry weather, and there was no evidence of water ever having remained for any considerable length of time in any of the places inspected.

Mosquitoes were collected at numerous points, and the only species found were *Aedes sollicitans*, the "white-banded salt marsh mosquito." These mosquitoes undoubtedly migrated from the undrained salt marshes nearby and harbored in the woods.

The conditions of Cedar Swamp Creek should be noted. Thousands of cedar trees have fallen across and in the creek and formed numerous blockages, and as far as could be determined there is about 3 feet of loose sand in the bottom. To remove the above obstructions, were it necessary, would run into large figures.

On October 7 the territory about Dennis Creek was inspected in the same manner. The cedar growth is so thick that passage through was impossible, except by way of an old corduroy road, which runs directly across.

The top soil on either bank is about 15 inches thick and composed of a peat formation in the first stages of decomposition saturated with water. There

was no surface water. Whether or not the entire area on both sides is of such a character could not be determined because of the impassable nature of the growth.

Samples of water were taken at different points. In the area where tidal action ceases the water becomes practically sterile; almost no living organisms of any kind were found. It is fortunate, from a mosquito breeding standpoint, that this is so, for mosquitoes could not breed in such water.

What adult mosquitoes were found were *Aedes sollicitans*, the same species found in Cedar Swamp Creek.

This creek contains about 5 feet of soft, sandy mud. A pole of that length was very easily sunk to that depth. The mud may be deeper, but we had no means of determining the depth. Like Cedar Swamp Creek, there are large numbers of cedar logs blocking the flow.

To cut a connection between the two creeks low enough and wide enough to allow a complete circuit of water could be done only at a large cost, and, from a mosquito breeding standpoint, would be useless. To get complete drainage on Cedar Swamp Creek would necessitate the repair of the old tide gate at Petersburg, which would shut out all tidal action. The meadow land on either side of the creek would then gradually become fresh, as was the case several years ago, when the gate was new.

It is the opinion of the writer that no broods of mosquitoes ever emerge from either section, and what few mosquitoes might breed in isolated spots are of a negligible quantity. Except for land-reclamation purposes, the writer recommends that nothing be done.

Burlington City and Burlington Township

At the requests made by the boards of health of Burlington Township and Burlington City, mosquito surveys were made on November 15 and December 4, 1923. It was found that the problem of mosquito control in these two places was one of the control of fresh water mosquitoes only, and resolved itself into ditching those swamps and pools which contain breeding, a treatment with oil of those places which are incapable of drainage, a periodic inspection of all back yards for receptacles that are capable of holding water, and, finally, the education of the citizens to a point where they will voluntarily control breeding on their own premises.

An estimate of $600 was submitted and the money was raised. A complete account of the work to date is given under the heading of Municipal Work.

Ocean City

On December 20, 1923, at the request of Mr. Joseph Champion, mayor of Ocean City, and accompanied by Dr. Howard Taylor, commissioner of the Cape May County Mosquito Commission, a survey was made. The problem is very similar to that found in Burlington, with the exception that the city limits include areas of salt marsh. An estimate was submitted for a complete campaign from June 1 to October 1.

Avalon

On December 12, 1923, at the request of Mr. Street, of Avalon, a mosquito inspection was made and a verbal report rendered to the mayor. It was found that the local conditions warranted only an oiling campaign to take care of the local breeding places.

Passaic Valley

The problem of the drainage of the Upper Passaic Valley for mosquito control has been a constant source of discussion by those mosquito control commissions whose territories lie partly in the valley. Realizing that complete drainage of the entire valley requires an expenditure of money far in excess of the amount of money available from the commissions concerned, the matter was placed in the hands of the inter-county committee for study and subsequent recommendations.

The committee requested Mr. Walden to collect all available data on the subject, make a plan and submit an estimate for a systematic study and organize a survey party to assist him, and report back to the committee.

The problem, as outlined in Mr. Walden's report, was as follows:

(1) To find how much and what character of ditching must be cut or cleaned in each swampy area to insure the escape of the surface water under average summer weather conditions in a period not to exceed one week.

(2) To find what must be done to the main channel running through the swamp to accommodate the water from the swamp ditches.

(3) To what extent must the outlet stream be widened, deepened or cleaned to accommodate the water from the main channels.

County Work

Passaic County

In the past the Passaic County Commission has continued its usual policy of concentrating its main efforts at the centers of population, namely, Paterson, Passaic and their suburbs. This year the work has been extended to Mountain View, Pompton Lakes and Haskell. Conditions on the Morris County side of the Pompton River are bad, and in a measure offset the work on the Passaic County side. The problem of *Culex pipiens* breeding in the polluted waters of the Passaic River is still an important one. Two men patrol the river bank continuously and oil when necessary.

Bergen County

About 80 per cent of the salt marsh in Bergen County is now drained. With the completion of the new tide gate on Moonachie Creek Meadows, the area which lies between Little Ferry to the Paterson Plank Road at East Rutherford will be behind dikes.

With the exception of the Ramapo section, the upland portion of the county is now controlled. Campaigns are now being conducted by Woodridge, Emerson, Lyndhurst, East Paterson, Wallington and North Hackensack with the help of the commission.

Hudson County

Despite the unusually wet period this spring, when hundreds of acres of salt marsh of Hudson County have been inundated with water, no broods of salt marsh mosquitoes have merged to date. This year marks the completion of all mosquito ditching on the Kearny marshes, the worst salt-marsh breeding area in the county. A new point in drainage of the salt marshes behind dikes has been tried in installing large sumps or basins in the rear of the tide gates to allow for a more continued functioning of the ditches while the gates are closed. Several acres of upland have been permanently filled.

Essex County

With the exception of that portion of the county lying within the Passaic Valley, the drainage is complete. Other than maintenance and changes in drainage, due to constantly changing industrial conditions, the salt marsh of Essex County is 100 per cent drained. A new feature of the salt-marsh work is the separation of the polluted upland waters from the salt-marsh water by the installation of dikes on the banks of the fresh water outlets. In this way the meadows are in no way affected by the waters from the upland. An unusual fresh water problem lies in the abandoned Morris Canal. A wide, deep stream of water was suddenly changed into a series of polluted pools across the county. Cooperating with the state authorities, the commission now has the problem well in hand.

Union County

All the salt marsh in this county lying east of the Central Railroad to Newark Bay is now behind dikes. The South Elizabeth meadow is partly diked. All told, this makes about 2,500 acres of a possible 4,000 acres diked and tide-gated. Much permanent upland work has been completed by filling large tracts of bad breeding area.

Middlesex County

With the exception of about 50 acres of salt marsh at Seidler's Beach, on Raritan Bay, the drainage of the salt marsh of Middlesex County is complete. By the end of this season this area will be finished. The commission has established a new policy this year in upland work. To encourage municipalities in starting upland campaigns the commission will plan and superintend all work on a 50-50 cost basis, matching dollar for dollar the amount raised by the municipality. Under this scheme campaigns have been started in Metuchen, Piscataway Township, Sewaren and Dunellen. Negotiations are now under way in Highland Park.

Monmouth County

Besides the regular maintenance of the salt marsh, the Monmouth County Mosquito Commission is initiating fresh water campaigns in the summer resorts. Long Branch and Rumsen, through their respective boards of health, are still employing inspectors to patrol their territories. The health officer of Neptune Township, at the instigation of the mosquito commission, is now draining and oiling some large tracts of breeding area. The Chamber of Commerce of Seabright is attempting to initiate a fresh water campaign.

Ocean County

The Ocean County Commission is still continuing its policy of expending its entire appropriation on its salt-marsh areas. Another contract for 150,000 or more feet of 10 by 30-inch ditching has been let to be placed on the salt marshes on the mainland, bordering Barnegat Bay between the Toms River road to Seaside Heights and Bay Head. To date, this contract is about one-third complete. With its completion great relief should be felt by the summer resorts on Barnegat Bay north of Seaside Heights and Toms River.

Atlantic County

No new ditching on the salt marsh has been cut by the Atlantic County Commission this year. A portion of its appropriation has been used on the building and perfecting of a new ditch-cleaning machine (mentioned elsewhere in this report), and the greater part of the remainder on the maintenance of

the present ditching system. Many of the main drainage systems have been completed this year by the installation of spurring.

Fresh water work in Atlantic City has been continued with its usual good results.

Cape May County

To date 212,500 feet of new ditching has been cut by the Cape May Commission on the salt marshes on the ocean side of the county. By the end of the present summer 575,000 feet will have been cut. While this will by no means finish the drainage of the salt marshes, it will complete the initial ditching on the strip of meadows between the upland and the nearest thoroughfare from Cape May to the Ocean City Boulevard, where it meets the state ditching. As the meadow next to the upland is conceded to be the worst breeding place on any salt marsh, a very definite effect ought to be noticed as a result of this drainage The remaining marshes east of the thoroughfare mentioned previously must be drained, for they are potential breeders.

On the Bay Shore meadows 11,420 feet of new ditching have been installed during the past season and the outlets have been improved.

Cape May City is still conducting a fresh water campaign, and steps are now being taken by the commission to extend its upland work.

Municipal Work

Burlington City and Township

As mentioned previously, an estimate for $600 was submitted to cover the work in Burlington and Burlington Township from June 2 to September 27. This money was to be appropriated equally by the city and township. The city appropriated its $300 but the township refused to appropriate more than $120. Thanks to the Burlington Woman's Civic League, the remaining $180 was raised by a moving picture benefit.

The city and township of Burlington are planning a very active mosquito control campaign, and to date have been very successful. Their publicity campaign has been very well worked out and is very highly successful. Newspaper publicity was arranged for and periodic articles have appeared in the paper, together with favorable editorials. The moving picture was shown in the moving picture houses for 2 weeks and a 4-scene pageant was presented by the boys and girls of the third, fourth and fifth grades. Mosquito manuals were distributed to each child in the schools and each teacher was requested to give at least one lesson on the mosquito control subject. A mosquito exhibit was arranged and held at a local department store. Posters were printed and distributed broadcast.

An inspector has been appointed to take immediate charge of all the field work. The work to date has been well done and the results are already noticeable in the decrease of the pest compared with its presence last year.

Prevalence of Mosquitoes During the Year

The months of July, August and September, in 1923, were remarkable throughout the state generally for a lack of mosquito prevalence. The salt marsh work of the commissions was greatly enhanced by the almost continuous spell of dry weather. Three broods emerged from the undrained marshes of each of the counties of Ocean, Atlantic and Cape May. Only 2 of the broods in Atlantic County migrated as far as Atlantic City, where they were prevalent for 4 or 5 days, and 1 brood from the northern Cape May County marshes migrated to Ocean City and remained for 3 days.

Despite the heavy rains of this spring and the early summer months, neither salt marsh or fresh-water mosquitoes have in any part of the state been prevalent to the point where they could be classed as a real pest.

No broods have to date emerged from the salt marshes of Hudson, Essex, Union, Bergen, Middlesex or Monmouth Counties. In Ocean County 1 brood of *Aedes sollicitans*, lasting about 5 days, emerged from the undrained marshes near Tuckerton in the latter part of June. A rather heavy brood from the northern part of Atlantic County got as far as Atlantic City during the latter part of May and was troublesome for about 1 week. A flight of *Aedes sollicitans* in Upper township in Cape May was noticed for about 3 or 4 days in the latter part of June.

Fresh-water mosquitoes have not been troublesome in any large section of the state. One brood of *Aedes sylvestris* and *Aedes canadensis* was very annoying in and around Mountain View during the latter part of May. A large brood of *Aedes sylvestris* emerged from the lower meadows of the Upper Passaic Valley, but, fortunately, it did not migrate, and disappeared without annoyance to the surrounding towns.

Correlation of Mosquito Commission Work

Insofar as possible the entomologist and the writer have attended the meetings of the 10 active mosquito commissions, where it was thought the services of the experiment station would be of use. By way of further correlation of the work of the commission, both the entomologist and the writer have taken an active interest in the monthly meetings of the Associated Executives.

As mentioned in last year's report, an organization known as the "Inter-county Committee" was formed to discuss, plan and execute mosquito control work of a cooperative nature. Conditions arose from time to time in which it was found that control work in sections which included parts of two or more counties could be done more economically and more efficiently with the commissions acting as a whole rather than as individual units. The membership of the committee composed two representatives from Hudson, Essex, Bergen and Union Counties and Dr. Headlee. A study of the Hackensack Valley control work was undertaken and considerable progress was made. A study of the Passaic Valley was considered and the Passaic County Commission joined the committee by sending two representatives. The effect of the work of this committee is being felt.

Educational Work

During the course of the year the writer, in answer to regularly presented requests, has shown the moving picture and given lectures on mosquito control. We believe that many benefits are derived from these lectures, not only familiarizing the public with the valuable

results of the control work, but in showing municipalities how to start control campaigns. A list of the lectures follows:

Place	*Organizations*	*Date*	*Remarks*
Atlantic City..	Rotary Club................	Oct. 16..	Lecture given by Chief Inspector of Atlantic County Commission
Mount Holly...	Rotary Club................	Nov. 14..	
Burlington	Women's Club..............	Dec. 4..	Campaign started
Ocean City....	Chamber of Commerce.......	Dec. 11..	Campaign started by Board of Health
Salem	Women's Club..............	Mar. 24..	
Chester	Women's Club..............	May 8..	
Chatham	Chatham Board.............	May 14..	Campaign started by Board of Health
New Brunswick.	Kiwanis Club...............	May 20..	

At the last convention of the New Jersey Mosquito Extermination Association held in Atlantic City last February, Mrs. Charles Lee, president of the New Jersey State Federation of Women's Clubs, and Mrs. Bertha H. Boynton and Mrs. Charles A. Prickitt, representatives of the federation, told of the work accomplished in the women's clubs by lectures and discussions. Municipal campaigns have been started through their efforts.

Plans for the distribution of the "Mosquito Manual" by the women's clubs in the eighth and high school grades in counties where there are no mosquito commissions are now under way.

The scheme of broadcasting mosquito control lectures on the radio, as mentioned in last year's report, was continued this year. The 3 lectures broadcast from Station W O R last June were repeated in September from Station W I P in Philadelphia through the courtesy of Gimble Brothers. This year a series of two mosquito control lectures, covering the subject of what the citizen can do to help, were given on June 2 and June 23 through the courtesy of L. Bamberger & Company, of Newark, from Station W O R. These lectures will be repeated from W I P on July 22 and August 14.

We have received many favorable comments from these lectures, and feel that real progress in the dissemination of mosquito control information has been made.

Work With Other Agencies

New Jersey Mosquito Extermination Association

The New Jersey Mosquito Extermination Association has completed its eleventh year of service. The eleventh annual meeting was held in Atlantic City, at Hotel Traymore, on February 13, 14 and 15, and

was well attended. Experts read very excellent papers, which covered the progress of mosquito control work throughout the world. Two thousand copies of the proceedings of this meeting are now being printed and will be distributed among the mosquito commissions and other organizations interested.

Associated Executives of Mosquito Control in New Jersey

The Associated Executives of Mosquito Control in New Jersey has had regular monthly meetings during the course of the year, during which the members have conferred on policies and inter-county work. Reports from the various commissions were made at each meeting and common problems were discussed. Probably the three most important types of work accomplished have been:

(1) The obtaining of specifications for road culverts to be placed in the State Highway Commission's standard specifications, which will prevent the formation of mosquito breeding places, resulting from the construction of the roads.
(2) The formation of a complete set of ditching standards to be used in ditching salt marsh meadows enclosed with dikes.
(3) The partial revision of the moving picture reel which has been shown for over a year.

The matter of a complete study of the effect of different styles of ditching on the vegetation of the open salt marshes is now being considered and plans are under way for such a study.

The New Jersey State Federation of Women's Clubs

Under the auspices of the New Jersey State Federation of Women's Clubs, lectures accompanied by the moving picture film have been given by Mrs. Bertha H. Boynton at practically every club within the state. The value of such lectures cannot be estimated. It was through these lectures that the township of Burlington and the city of Burlington are now engaged in active mosquito control work. At the convention of the New Jersey Mosquito Extermination Association it was suggested by the representatives of the women's clubs that the matter of distributing the mosquito manual to the children in counties where no active mosquito control work is now going on should be taken up by the women's clubs. This will be done this year.

Report of the Department of Plant Pathology

Wm. H. Martin

The activities of the department of plant pathology followed along the lines which were pursued the preceding year. The departmental staff has given its attention to:

(1) The investigation of the fungi injurious to agricultural and ornamental crops. Extensive studies were conducted on the diseases of the apple, egg-plant, oats, pea, pepper, potato, sweet potato and tomato.

(2) The furnishing of information concerning the nature and control of fungi causing plant diseases in response to inquiries from citizens of the state. The correspondence this year required the preparation of about 3,000 letters.

(3) The continuance of studies relative to the growing of potatoes. Studies were conducted in cooperation with the Bureau of Plant Industry to determine the relative value of northern and southern grown seed potatoes. Tests were conducted in cooperation with the Office of Soil Fertility, United States Department of Agriculture, to determine the fertilizer requirements of the potato. The department also cooperated with the county agents in extensive seed source and variety tests.

(4) The preparation of bulletins and circulars setting forth the result of investigations of plant diseases. The continuance of "Plant Disease Notes." This was issued monthly during the past year and sent to all extension workers. The purpose of this publication is to present pertinent facts concerning plant diseases. During the year the department prepared 1 station circular, 7 technical articles and 30 popular articles.

(5) The preparation of an exhibit for the Exposition International Du Centenaire De Pasteur held at Strasbourg, France. This exhibit, which consisted of enlarged photographs showing the results of disease control studies, was awarded a Diploma de Grand Prix.

(6) The cooperation with the Plant Disease Survey of the United States Department of Agriculture. The purpose of this survey is to record the presence and severity of diseases in the state. During the year 165 diseases were reported.

(7) The continuance of our cooperation with the State Department of Agriculture in plant disease problems. Particular attention has been given to the certification of both white and sweet potatoes. As a part of the certification work with white potatoes, all lots of seed certified in 1922 were tested in the spring of 1923. This work proved to be of so much practical value that it is being continued this year.

PLANT DISEASES OF THE YEAR 1923

Alfalfa

Leaf Spot (*Pseudopeziza medicaginis* [Lib.] Sacc.). Generally distributed, but less prevalent than last year.

Apple

SCAB (*Venturia inaequalis* [Cooke] Wint.). Present in some orchards in the vicinity of Hammonton, but not severe in other localities.

FIRE BLIGHT (*Bacillus amylovorus* [Burr.] Trev.). General over the state, especially severe in plantings of the Starr variety in the vicinity of Bridgeton.

CROWN GALL (*Bacterium tumefaciens*) E. F. Smith and Townsend. Aerial and root form observed on 20-year-old Williams. In the same orchard the Jonathan and Paragon showed root infection, but no aerial galls.

BLOTCH (*Phyllosticta solitaria* E. & E.). Severe on Smith Cider variety, where it was not controlled by the regular spray schedule. Slight infection observed on the Dutchess.

FRUIT SPOT (*Phoma pomi* Passer). Observed on the King David variety. Not so widely distributed or so severe as in 1922.

BLACK ROT (*Physalospora cyoniae* Arnaud). Less than in 1922. Slight infection of the fruit on the Winter Banana, Williams Favorite and Smith Cider.

BITTER ROT (*Glomerella cingulata* [Stoneman] Sp. & von S.). Not severe. Slight infection on the Winter Banana in Monmouth County.

RUST (*Gymnosporangium juniperi-Virginianae* Schw.). Slight infection reported from Monmouth County on the Winter Banana.

SOOTY BLOTCH OF FLY SPECK (*Leptothyrium pomi* [Mont. and Fr.] Sacc.). This trouble was reported to be rather general in the northern counties of the state.

WATER CORE (Cause unknown). Several fruit of the Smith Cider variety were observed to show this trouble.

BITTER PIT (Cause unknown). Several reports were received concerning this disease, indicating it to be less severe than in previous years.

JONATHAN SPOT (Cause not determined). Severe on a lot of Jonathans held in cold storage.

SUN SCALD. Some fruit russeted or cracked; less severely injured specimens showed only a browning or whitening of the tissue. The Stamen, Paragon and Baldwin appeared to be susceptible to sun scald while the Wealthy and Delicious were more resistant.

SCALD. Several reports of this trouble. In one case more than 80 per cent of the fruit severely injured. The fruit was in cold storage, but no records could be obtained as to the temperature maintained.

SPRAY INJURY. Severe burning of the fruit and leaves observed following spraying with concentrated lime sulfur and Bordeaux mixture. In some cases the fruit was severely cracked, in others the injury was slight, but the per cent of drops was quite heavy.

Aster

WILT (*Fusarium conglutinans Wall.* var. *callistephani* Beach). Severe in both southern and central Jersey.

YELLOWS (Cause unknown). Prevalent, but not severe.

Asparagus

RUST (*Puccinia asparagi* D. C.). Severe in Gloucester County and rather generally distributed over South Jersey.

Bean

ANTHRACNOSE (*Colletotrichum lindemuthianum* [S. & M.] B. & C.). While common, this trouble was not so severe as usual.

DOWNY MILDEW (*Phytophthora phaseoli* Thaxt.). Not observed in the early crop. Severe in the late summer in Gloucester, Camden and Burlington Counties. In one field in Camden County 100 per cent of the plants diseased.

POD BLIGHT (*Diaporthe phaseolorum* [C. & E.] Sacc.). Found in Camden County on pods of lima beans.

RUST (*Uromyces appendiculatus* [Pers.] Link). Leaf infection found locally, but not rated as of any consequence.

Beet

Leaf Spot (*Cercospora beticola* Sacc.). Present in all parts of the state, but not so severe as usual.

Root Spot (*Rhizoctonia betae* Kühn). Single report from Essex County.

Scab (*Actinomyces scabies* [Thaxt.] Guss.). Reported from Cumberland County, but less severe than in previous years.

Blackberry

Orange Rust (*Gymnoconia interstitialis* [Schlecht] Lager). This trouble was present in various parts of the state, particularly common in the southern counties.

Leaf Spot (*Septoria Rubi* Westd.). Severe on the Blackberry at New Brunswick. Not considered of economic importance.

Cabbage

Club Root (*Plasmodiophora brassicae* Wor.). Present, but not severe in Monmouth County.

Yellows, Wilt (*Fusarium conglutinans* Woll.). Severe in Camden and other southern counties. In one field of ¼ acre in Camden County every plant infected. This seed had been sterilized with $HgCl_2$ and planted in sterile seed bed. In one field of Copenhagens 96 per cent of plants diseased. In a planting of Early Jersey Wakefield adjoining these there was less yellows.

Cauliflower

Black Rot (*Pseudomonas campestris* [Pam] E. F. S.). Severe in several small plantings in north Jersey, 25 per cent of the plants badly diseased.

Cantaloupe

Leaf Blight (*Alternaria brassicae* [Berk.] Sacc.). Generally distributed over south Jersey. Serious defoliation in many fields. In others, leaves heavily infected but no defoliation occurred.

Cedar

Rust (*Gymnosporangium juniperi-virginianae* [Schw.]). Found in Monmouth County. Not abundant.

Celery

Heart Rot (*Bacillus carotovorus* Jones). Present in the celery growing sections of north Jersey, but less severe than in any of the past 5 years.

Late Blight (*Septoria petroselini* [Desm.] var. *apii* Br. & Cav.). Not serious this year. Slight losses reported on irrigated fields.

Early Blight (*Cercospora apii* Fr.). Generally present, but caused less damage than at any time during the past 5 years.

Cherry

Brown Rot (*Sclerotinia cinerea* [Bon.] Schrot.). Less common than usual.

Black Knot (*Plowrightia morbosa* [Schw.] Sacc.). Reported, but not considered of economic importance.

Leaf Spot (*Coccomyces hiemalis* Higgins). This trouble was not so severe as usual.

Chestnut

Blight (*Diaporthe parasitica* Murrill). Generally present.

Chrysanthemum

Mildew (*Oidium Chrysanthemi* Rab.). Common on plants grown under glass. In the greenhouse at New Brunswick, the trobule was severe on the variety Mrs. Voight, less severe on Elbeson, Percy Dove and Babby, slight on Marigold, C. Twigg and H. V. West, while the varieties Wm. Turner, Yellow Turner and Chieftain showed no infection.

Wilt (*Verticillium albo-atrum* R. & B.). This trouble has been under observation during the past 6 years both on plants grown under glass and outdoors. The Pink Seilewich, Early Snow and P. A. Dove variety are very susceptible.

Clover

Mildew (*Erysiphe polygoni* D. C.). General over the state, but less abundant than in the past several years.

Corn

Root Rot (*Fusarium* sp.). Common on field and sweet corn in all parts of the state. Ten per cent infection in one field of sweet corn in north Jersey.

Smut (*Ustilago zeae* [Beckm.] Ung.). Generally found in all parts of the state. Severe on sweet corn in vicinity of Hazlet, in Monmouth County.

Cow-pea

Leaf Spot (*Amerosporium oeconomicum* E. & T.). This disease was severe locally in the vicinity of Toms River.

Powdery Mildew (*Erysiphe polygoni* D. C.). Common in Cape May County. Leaves, pods and stem affected.

Augular Leaf Spot (*Cercospora cruenta* Sacc.). Common in all parts of the state, but not severe.

Cranberry

Scald or Blast (*Guignardia Vaccinii* Shear). Much less severe than in 1922 and less severe than usual. Approximately 15 per cent of blossoms infected, less than 5 per cent of the fruit.

Rot (*Acanthorhynchus Vaccinii* Shear). Less than in 1922, but about the same as in the average year. Especially important in stored berries.

Cucumber

Leaf Spot (*Phyllosticta cucurbitacearum* Sacc.). Not severe, but rather generally distributed in Gloucester County.

Wilt (*Bacillus tracheiphilus* E. F. S.). Widely distributed in the southern counties. In one field in Gloucester County every plant affected.

Leaf Blight (*Alternaria brassicae* [Berk.] Sacc.). In a planting at New Brunswick 75 per cent of the leaves were killed.

Anthracnose (*Colletotrichum lagenarium* [Pass.] E. & H.). Common in Gloucester County on leaves and fruit. In a number of fields examined most of the old fruit, which was infected, showed the trouble at the stem end.

Downy Mildew (*Peronoplasmopara cubensis* [B. & C.] Clint.). Not generally distributed, found only in low areas in fields in the southern counties.

Currants

Anthracnose (*Pseudopeziza Ribis* Klebahn). Slight infection on canes at New Brunswick.

Leaf Spot (*Mycosphaerella grossulariae* [Fr.] Lind.). Reported from north Jersey, but not severe.

Dahlia

Wilt (*Fusarium* sp.). One report of the trouble from New Brunswick.

Eggplant

LEAF SPOT AND FRUIT ROT (*Phomopsis vexans* [Sacc. & Syd.] Hart.). While this trouble was generally distributed the losses were slight, due to the late appearance of the disease.

WILT (*Verticillium albo-atrum* [McA.] R. & B.). The extreme droughts in some sections of the state caused an increase in the losses from wilt. The trouble was reported from all parts of the state and was more abundant than usual.

ANTHRACNOSE (*Colletotrichum* sp.). Not important, in one field at New Brunswick 2 per cent of the fruit was infected.

Gladiolus

WILT (*Fusarium* sp.). Several infected plants observed at New Brunswick.

Gooseberry

ANTHRACNOSE (*Pseudopeziza Ribis* Kleb.). Slight infection observed at New Brunswick.

Hollyhock

RUST (*Puccinia malvacearum* Mont.). Common in south Jersey.

Horse Chestnut

LEAF SPOT (*Guignardia aesculi* Stewart). Common in all parts of the state.

Horse Radish

BLACK MOLD (*Macrosporium herculeum* E. & M.). Slight infection reported from Swedesboro section.

ROOT ROT (*Bacillus* sp.). Caused a slight loss of roots in May and June, due probably to infection in the storage pits. Very little of the trouble observed in November.

ROOT ROT (*Thielavia basicola* [B. & Br.] Zopf.). Losses slight. Some infection observed in May and June. Light infection of harvested roots.

Lilac

POWDERY MILDEW (*Microsphaera alni* [Wallr.] Salm.). Common in all parts of the state.

Lettuce

DROP (*Sclerotinia libertiana* Fcl.). Severe in some fields in Cumberland County.

Oats

SMUT (*Ustilago avenave* [Pers.] Jens.). General over state. Three fields in Monmouth County showed 12, 5 and 1 per cent, respectively. One field in Middlesex County showed 6 per cent.

RUST (*Puccinia coronata* Cda.). Generally distributed and common in many fields.

Parsley

LEAF SPOT (*Septoria petroselini* Desm.). Reported from Riverton, not severe.

EARLY BLIGHT (*Cercospora apii* Fr.). Found at Riverton, not severe.

Pea

Root Rot (Cause undetermined). Severe in southern counties of the state, particularly on the lighter soil types. Also reported from Morris County. This disease was quite severe, causing a reduction of 25 per cent in the pea crop. In a number of cases every plant in a field showed infection.

Peach

Bacterial Spot (*Bacterium pruni* E. F. S.). Common in young orchard at New Brunswick. At Riverton the Elberta variety severely infected.

Scab (*Cladosporium carpophilum* Thum.). Less troublesome than usual. Severe in some orchards, but not generally distributed. In Cumberland, counts were made on unsprayed trees of different varieties with the following results: Carman, 62.2 per cent scab; Lolas, 38.5 per cent; Hilleys, 35.2 per cent. In Atlantic County, a planting of the Greensboro variety showed 75 per cent infection.

Brown Rot (*Sclerotinia cinerea* [Bon.] Schr.). Present in some parts of the state, but not severe.

Shot Hole (*Phyllosticta circumscissa* Cke.). Present, but not severe in south Jersey.

Wilt (*Verticillium albo-atrum* [R. & B.]). This trouble was not reported. Its sudden appearance in 1921 in young orchards, the decrease in 1922 and its disappearance in 1923 suggest that it is a minor trouble and possibly associated with weather conditions.

Spray Injury. A number of orchards were observed in which there was considerable spray injury. In one orchard in Cumberland County the trees were almost defoliated following the use of atomic sulfur. The injury, while less severe in orchards sprayed with self-boiled lime sulfur and dry-mix, was present to some extent. At New Brunswick considerable injury was present on trees sprayed with dry-mix. The leaves were burned and large cankers were observed on both the old and new wood.

Pear

Fire Blight (*Bacillus amylovorus* [Burr.] Trev.). Generally distributed. In some cases 15 per cent of the young branches killed.

Leaf Blight (*Fabraea maculatum* [Lev.] Atk.). Not so abundant as usual, but common in unsprayed orchards.

Leaf Spot (*Mycosphaerella sentina* [Fr.] Schr.). Present, but not severe in orchards in south Jersey.

Pepper

Leaf Spot (*Phyllosticta* sp.). Found on leaves and fruit in planting at Riverton.

Black Mold (*Macrosporium* sp.). Common in south Jersey.

Mosaic (Cause unknown). Generally distributed over the state. Severe in some fields.

Root Rot (*Rhizoctonia* sp.). Cause of heavy losses in some plant beds.

Plum

Black Knot (*Plowrightia morbosa* [Schw.] Sacc.). Several reports of the trouble were received from various parts of the state.

Potato

Wilt (*Fusarium oxysporum* Schl.). This trouble was much more severe than it has been at any time in the past 7 years. While it was not generally distributed throughout the state, fields were observed in both central and south Jersey where a large number of plants, 5 to 100 per cent, were affected.

BLACK LEG (*Bacillus phytophthorus* Appel). This trouble was observed in only several fields. In a seed-source test in south Jersey non-certified Maine seed showed 10 per cent infection. A trace of the disease was also found in several fields in Cumberland County.

SPINDLE TUBER (Cause undetermined). Not serious, but found rather generally in the Irish Cobbler variety. In one field in south Jersey 15 per cent of the plants were affected.

YELLOW DWARF (Cause undetermined). One plant affected with this trouble found in a 20-acre field planted with New York-grown seed.

MOSAIC (Cause undetermined). Severe in some plantings of the American Giant and Green Mountain varieties. In one case a field of the former variety showed 73 per cent mosaic. Present, but not severe in the Irish Cobbler variety.

RHIZOCTONIA (*Corticium vagum* B. & C.). In one field in south Jersey 75 per cent of the plants affected. Less common than usual.

TIP BURN (Cause undetermined). Some injury in every field examined. Losses quite severe in some cases.

LEAF ROLL (Cause undetermined). Especially severe on the Irish Cobbler variety, present on the American Giant and Green Mountain. One field observed with 95 per cent of the plants affected.

EARLY BLIGHT (*Alternaria solani* [E. & M.] J. & G.). Trace found on commercial crop in central Jersey; present, but not severe on late crop in south Jersey.

SCAB (*Actinomyces scabies* [Thaxt.] Güss.). Less severe than usual. In variety test the following results were secured: Green Mountain, 6.2 per cent clean; Irish Cobbler, 21.5 per cent; no. 9, 50 per cent; Rural New Yorker, 50.4 per cent; Rural Russets, 57.1 per cent; Burbank, 61.8 per cent.; American Giant, 62.6 per cent. Fields of Irish Cobblers were observed in which 100 per cent of the tubers were affected.

Quince

FIRE BLIGHT (*Bacillus amylovorus* [Burr.] Trev.). Present, but not severe.

LEAF AND FRUIT SPOT (*Fabraea maculata* [Lev.] Atk.). Not severe.

Raspberry

MOSAIC (Cause unknown). Present in all parts of the state. Severe on the Cuthbert variety.

ANTHRACNOSE (*Plectodiscella veneta* Burke). Generally prevalent and considered the most important disease of the raspberry. In a spray test in Atlantic County only 25 per cent of the canes were free from the trouble and compared with 97 per cent on plots sprayed with concentrated lime sulfur.

LEAF SPOT (*Septoria rubi* West.). Prevalent in all plantings, but not of economic importance.

CROWN GALL (*Bacterium tumefaciens* E. F. S. & Townsend). Found in all parts of the state.

CANE BLIGHT (*Leptosphaeria coniothryium* [Fckl.] Sacc.). Generally prevalent, but not severe.

ORANGE RUST (*Gymnoconia interstitialis* [Schl.]). Common in central and southern Jersey.

Rose

POWDERY MILDEW (*Sphaerotheca pannosa* [Wallr.] Lev.). Very abundant, especially on the crimson rambler.

BLACK SPOT (*Diplocarpon rosae* Wolf). Slight infection found in greenhouses at Bridgeton.

LEAF SPOT (*Phyllosticta rosicola* Mass.). One report on roses at New Brunswick.

ROOT KNOT (*Heterodera* sp.). One report on plants under glass.

CROWN GALL (*Bacterium tumefaciens* E. F. S. & Townsend). Heavy infection noted in one greenhouse.

GRAFT CANKER (*Coniothyrium rosarum* Cke. and Harkn.). Fifteen per cent infection reported in one greenhouse in Basking Ridge.

Rhododendron

LEAF SPOT (*Pestalozzia guepini* [Desm.] var. *vaccinii* Sh.). Common in one nursery on lower leaves of young plants.

Rhubarb

LEAF SPOT (*Ascochyta rhei* E. & E.). Leaves in a planting at New Brunswick badly spotted.

(*Phytophthora* sp.). Several reports of this trouble from the Woodbury section.

Snap Dragon

ANTHRACNOSE (*Colletotrichum antirrhini* Stewart). Heavy infection of plants under glass in Mount Holly.

Sunflower

RUST (*Puccinia Helianthi* Schw.). Generally found in all parts of the state.

Strawberry

LEAF BLIGHT (*Mycosphaerella fragariae* [Tul.] Lindau). Generally prevalent and in some instances quite severe.

Sweet Potato

BLACK ROT (*Sphacronema fimbriatum* E. & H. Sacc.). Generally prevalent but less severe than last season. Approximately 20 per cent of the fields examined showed infection amounting to 1 per cent of the plants. The reduction in yield due to this disease was less than ½ per cent. Most injury was observed in the low areas in fields.

POX OR SOIL ROT (*Cystospora batatae* [E. & H.] Ell.). Very destructive in some sections, particularly in the Swedesboro and Vineland areas. Approximately 20 per cent of the fields examined were affected, in some cases the number of infected plants amounting to 100 per cent. The losses to the crop from this disease are placed at 5 per cent.

WILT, YELLOWS OR STEM ROT (*Fusarium batatatis* Wolln. and *F. hyperoxysporum*). Much more prevalent than in the average year. Sweet potato vines killed by stem rot averaged 30 per cent for all fields and the crop was reduced approximately 30 per cent. Excellent results in the control of stem rot were secured by the use of resistant varieties.

SCURF (*Monilochaetes infuscans* Hals.). Not so severe as last season While the trouble was found generally, the losses to the crop amounted to less than ½ per cent.

SOFT ROT (*Rhizopus* sp.). Caused slight loss of potatoes in storage.

SURFACE ROT (*Fusarium oxysporum* Schl.). Slight loss in some storage houses.

LEAF SPOT (*Septoria bataticola* Taub.). Less prevalent than usual and of no economic importance.

CHARCOAL ROT (*Sclerotium bataticola* Taub.). Less abundant than usual and of no importance.

LEAF SPOT (*Phyllosticta bataticola* E. & M.). Present in some areas but of no economic importance.

WHITE RUST (*Albugo ipomoeae panduranae* [Schw.] Swing.). Slight infection found.

Tomato

LEAF SPOT (*Septoria lycopersici* Speg.). Less prevalent than last season. Reported on late tomatoes, but no severe.

EARLY BLIGHT (*Macrosporium solani* E. & M.). Generally found, but not of economic importance.

WILT (*Fusarium lycopersici* Sacc.). Much more abundant and severe than last year. In one field where the trouble was not present the previous year, all of the plants were so badly affected just before blossoming that they were turned under. Approximately 80 per cent of the fields examined showed infection. The crop was reduced about 3 per cent.

BLOSSOM END ROT (Cause unknown). More prevalent than at any time in the past 4 years. Every field showed infection, varying from 10 to 23 per cent. The crop was reduced 3 per cent as the result of this disease.

ANTHRACNOSE (*Colletotrichum phomoides* [Sacc.] Chester). Very destructive during September.

MOSAIC (Cause unknown). Generally prevalent. Found on the Acme, Earliana, Bonny Best and Greater Baltimore tomatoes.

SOFT ROT (*Oidium oospora lactis*). Common following growth cracks.

ROOT KNOT (*Heterodera radicicola* [Greef] Muller). One report on tomatoes grown under glass.

Watermelon

WILT (*Fusarium vasinfectum* [Atk.] Erw. Smith). Prevalent in many fields, causing from 1 to 25 per cent loss.

ANTHRACNOSE (*Colletotrichum lagenarium* [Pers.] E. & H.).

Wheat

RUST (*Puccinia coronata* Cda.). Generally distributed over state.

POTATO SPRAYING AND DUSTING IN 1923

WM. H. MARTIN

As in previous years, spraying tests were conducted with both the commercial crop and late-planted potatoes grown for seed purposes. On the former, the tests were designed to compare copper-lime dusts with commercial and home-made Bordeaux. On the late crop, a comparison was made of 5-5-50 Bordeaux mixture prepared with stone and hydrated lime and also a 10-10-50 mixture. The results of the various tests are discussed below.

Tests With the Commercial Crop in Cooperation with J. H. Kandle, Elmer, N. J.

This test was conducted with the Irish Cobbler variety planted on April 12. The field in which the work was conducted was without irregularities, and the soil, a sassafras loam, was in excellent condition for the growing of the crop. The area included was divided into 25 plots, each 4 rows wide, allowing for 5 replications of each treatment with a check plot between each 3 treated plots. In this test

the following materials were included: (1) 5-5-50 Bordeaux mixture, (2) commercial Bordeaux mixture (Pyrox), (3) 5-5-50 Bordeaux mixture plus Kayso, used at the rate of 1½ pounds per 100 gallons of Bordeaux. Each of these mixtures was applied at the rate of 100 gallons per acre, and all spray applications were made with a pressure of 175 pounds. The spray machine used for the work was a traction machine equipped to spray 4 rows at a time, with 3 nozzles to the row.

The first spray application was made on June 20, when the vines were, approximately, 8 inches high. At this time the plants were free from any foliage diseases. Some flea beetles and Colorado beetles were observed, but no leaf hoppers were found. The check plots were sprayed with arsenate of lead on June 20 and June 27, while the remaining plots were sprayed on these dates, and also on June 27, July 9 and 18. At the time of the last application, tip-burn and hopper-burn injury were severe. On July 18, observations were made on the different plots included in the test to determine the number of dead leaves on each. Counts were made of the leaves killed as the result of hopper-burn and tip-burn on every tenth plant in one of the center rows of each plot. On the check plots and average of 54.4 per cent of the leaves were dead as compared with 5.8, 10.3 and 3.4 on the plots sprayed with Bordeaux, Pyrox, and Bordeaux plus Kayso, respectively. It is apparent from these results that the control of tip-burn and hopper-burn resulting from the use of these three materials was approximately the same. In connection with these three sprays, it should be stated that no differences were observed during

TABLE 1

Arrangement of Plots and Yield Per Acre in the Spraying Test With Commercial Crop Irish Cobblers

TREATMENT	Yield Per Acre	Corrected Yields	Difference Due to Treatment
	bu.	*bu.*	*bu.*
Check	83.4	......	......
Bordeaux Mixture, 5-5-50	94.3	81.2	13.7
Pyrox	115.2	78.9	36.3
Bordeaux + Kayso	113.4	76.6	36.8
Check	74.3	......	......
Bordeaux Mixture, 5-5-50	119.5	84.0	35.5
Pyrox	123.3	93.7	29.6
Check	103.4	......	......
Bordeaux + Kayso	116.0	100.4	15.6
Bordeaux Mixture, 5-5-50	125.1	97.5	27.6
Pyrox	120.6	94.6	26.0
Bordeaux + Kayso	123.2	91.7	31.5
Check	88.8	......	......
Bordeaux Mixture, 5-5-50	127.9	93.3	34.6
Pyrox	125.1	97.8	27.3
Bordeaux Mixture + Kayso	126.0	102.3	23.7
Check	107.0	......	......

the growing season with regards their covering power or sticking qualities. After the first application the vines on the different plots were well covered with spray material, and, due to the fact that the season was very dry, little was washed from the leaves. This possibly accounts for the fact that no appreciable difference was observed in the plots sprayed with Bordeaux mixture and those sprayed with Bordeaux mixture plus Kayso.

The various plots included in the test were dug August 10 and the yield from the two center rows in each plot obtained. The results are presented in table 1. From a consideration of the average yields, it will be observed that the plots sprayed with Bordeaux mixture gave increases amounting to 27.7 bushels pere acre, those sprayed with Bordeaux mixture plus Kayso 26.9, and those with Pyrox 29.8 bushels. The plots sprayed with Pyrox gave slightly greater returns than those sprayed with home-made Bordeaux either with or without Kayso. The differences, however, were so small as to make it impossible to state that one treatment was superior to the other.

Spraying Test in Cooperation with I. B. Van Derveer, Freehold

The soil on which the test was conducted is a sassafras loam. The field was without irregularities either as to soil type or topography. In order to obtain information on the response of different varieties to applications of Bordeaux mixture, the field was planted with the Norcross, Irish Cobbler and American Giant varieties, and a spray test conducted with each.

Test with Irish Cobblers

In this test the first spray application was made on June 8, when the plants were, approximately, 8 inches high. Additional applications were made on June 15, 26, July 6, 17, 26, August 3 and 13. In this test a comparison was made of 5-5-50 Bordeaux mixture with and without Kayso and copper-lime dust carrying 6 per cent metallic copper. The latter material was applied in amounts as to give equivalent amounts of copper per acre to that obtained from an application of 100 gallons of 5-5-50 Bordeaux mixture.

During June there was no serious outbreak of insects and no foliage diseases were observed in the field. In early July, however, flea beetles became very abundant and were responsible for serious injury to the foliage of the check and dusted plots, while on the sprayed plots the injury was slight. This difference was so striking that counts were made on a number of leaves on July 11 to determine the average number of punctures on each. The results of this examination were of considerable interest, showing, as they did, a pronounced difference in control of this insect resulting from the use of the different fungicides. On the check plots, which received 2 applications of arsenate of lead early in the season, there was an average of 264 punctures to the leaf. The leaves from the plots dusted with copper-lime dust were

but little better, showing 246 punctures. On the plots sprayed with Bordeaux, with and without Kayso, there was a marked decrease in the number of punctures, the average on the former being 54 and on the latter 87.

During the last 2 weeks of July some early blight and considerable tip-burn made their appearance in the field. Some of this latter injury was no doubt due to the activities of leaf hoppers, since a number of these were present. Injury from these causes was particularly apparent by the first week in August. On the twelfth, counts were made of a representative number of plants in each plot to determine the number of dead leaves. On that date, on the check plots, 51.5 per cent of the leaves were dead as compared with 44.1 per cent on the plots dusted with copper-lime dust. Very little difference was apparent between these plots at any time during the growing season. On the plots sprayed with Bordeaux alone, 10.8 per cent of the leaves were dead and 12.2 per cent on the plots sprayed with Bordeaux+Kayso. This difference between these plots and those unsprayed and those dusted was manifested throughout the season, until the crop was dug on August 21, when all of the plants on the latter plots were dead, while on the former most of the leaves were still green.

The arrangement of the plots in the field, and the yield per acre on each plot, is given in table 2. In obtaining yields the potatoes from the 2 center rows of each 4-row plot were weighed. The plots in each case were, approximately, $^{1}/_{40}$ acre in size.

TABLE 2

Arrangement of Plots and Yield Per Acre in the Spraying and Test With the Irish Cobbler Variety (I. B. VanDerveer Farm)

TREATMENT	Series A			Series B		
	Yield per Acre	Corrected Yield	Difference due to Treatment	Yield per Acre	Corrected Yield	Difference due to Treatment
	bu.	*bu*	*bu.*	*bu.*	*bu.*	*bu.*
Check	233.3	....	....	227.1	....	....
Bordeaux, 5-5-50	248.8	237.6	11.2	225.2	230.6	24.6
Bordeaux + Kayso	265.2	241.9	23.3	259.7	234.1	25.6
Copper-Lime Dust	251.6	246.2	5.4	230.7	237.6	—6.9
Check	250.6	....	....	241.1	....	....
Bordeaux Mix. 5-5-50	247.5	243.4	4.1	246.6	241.2	5.4
Bordeaux + Kayso	240.7	236.3	4.4	243.4	241.3	2.1
Copper-Lime Dust	224.8	229.2	—4.4	217.6	241.4	—23.8
Check	221.1	....	....	241.6	....	....
Bordeaux Mix. 5-5-50	242.9	217.9	35.0	279.7	247.6	32.1
Bordeaux + Kayso	227.5	213.8	13.7	288.3	253.6	34.7
Copper-Lime Dust	210.0	209.7	0.3	251.1	269.6	—13.5
Check	205.6	....	....	265.6	....	....

The average yield of the check plots was 235.8 bushels per acre as compared with 253.4, 254.1 and 231.8 from those sprayed with Bordeaux, Bordeaux+Kayso and those dusted with copper-lime dust, respectively. It will be seen that, from the standpoint of increased yields, the addition of Kayso to the Bordeaux mixture resulted in no appreciable benefit. This may probably be accounted for by the fact that the season was exceptionally dry and the Bordeaux mixture without a sticker adhered to the leaf. The results obtained from the use of the copper-lime dust were by no means satisfactory, this despite the fact that this material, in every instance but one, was applied in the early morning, before the dew had left the leaves.

Test with the American Giant Variety

The results of previous spray tests with this variety have not been satisfactory, with the exception of the tests conducted in 1922, when an increase amounting to 79.4 bushels per acre was obtained. In that year, however, late blight was present and severe in the field in which the spray test was conducted. In the test this year the only diseases present in the field were tip-burn and hopper-burn, with a trace of early blight. Despite this fact, increased yields followed; these increases, however, were not so large as were obtained with Irish Cobblers and Green Mountains in the same field.

Two tests were conducted with the American Giant, one in which spray applications were made at, approximately, 10-day intervals throughout the season, beginning when the vines were about 7 inches high, and a second in which the first application was not made until the vines were fully grown. In the first test, 8 applications in all were made on the following dates: June 8, 15, 26, July 6, 17, 26, August 3 and 13. In the second test the first 4 applications were omitted. In both tests the only spray mixture used was the 5-5-50 Bordeaux mixture applied at the rate of 100 gallons per acre.

While the differences between the sprayed and unsprayed plots were not so marked as in the case of the Irish Cobbler and Norcross varieties, the results secured indicate that where the American Giant is properly sprayed an increase in yield can be expected even in a dry season. The various plots included in the 2 tests were dug September 25. The results obtained are presented in tables 3 and 4. In the first test the average yield of the check plots was 248.4 bushels per acre, and of the sprayed plots 272.7 bushels, an increase of 24.3 bushels. In the second test the average yield of the check plots was 189, and of the sprayed 207.4 bushels per acre, an increase of 18.4 bushels. It will be observed that the increased yield on the plots receiving 4 applications was nearly as large as that where double this number was made. This may be accounted for by the fact that tip-burn and hopper-burn, with a trace of early blight, did not appear until late in the season; in a year when early blight or late blight was especially severe, it is questionable if similar results would be secured.

TABLE 3

Arrangement of Plots and Yield Per Acre of the Spraying Test With the American Giant Variety (8 Applications)

TREATMENT	Yield per Acre
	bu.
Check	223.8
Bordeaux Mixture	258.0
Check	241.6
Bordeaux Mixture	275.8
Check	243.5
Bordeaux Mixture	281.7
Check	285.0
Bordeaux Mixture	276.5

TABLE 4

Arrangement of Plots and Yield Per Acre in the Spraying Test With the American Giants (4 Applications)

TREATMENT	Yield per Acre
	bu.
Check	186.0
Bordeaux Mixture	214.0
Check	216.5
Bordeaux Mixture	210.0
Check	170.0
Bordeaux Mixture	196.0
Check	183.5
Bordeaux Mixture	209.5

Test with the Norcross Variety

In the spray test with the Norcross variety, the different plots were sprayed on June 8, 15, 26, July 6, 17, 26, August 3, 13 and 27. During the early growing season no difference in vine growth was observed, but, as the season advanced, marked differences were noted in the number of dead leaves on the plots receiving the different treatments, the injury resulting from tip-burn, hopper-burn, and, to a slight extent, early blight. On September 6 a count was made to determine the number of dead leaves in each plot. The results of this count showed that an average of 93 per cent of the leaves on the unsprayed plants were dead, as compared with 90 per cent on those dusted with the copper-lime dust and 5 per cent on both the plots sprayed with Bordeaux mixture and those with Bordeaux mix-

ture plus Kayso. It is evident that the condition of the plots dusted with copper-lime dust was little better than that of the check plots, while the plants in the plots sprayed with Bordeaux mixture, with and without Kayso, were green and growing vigorously at this late date.

The various plots were dug on October 8. The yield per acre of each is shown in table 5. It will be observed from the table that while the yield of the treated plots, particularly those sprayed with Bordeaux mixture, varied somewhat, in every case it was considerably above that of both the untreated checks and the plots dusted with the copper-lime dust. The average yield of the various plots was: Check, 223.1 bushels; Bordeaux mixture, 272.6 bushels; Bordeaux mixture plus Kayso, 277.3 bushels, and copper-lime dust, 229.4 bushels.

TABLE 5

Arrangement of Plots and Yield Per Acre of the Spraying and Dusting Test With the Commercial Crop Norcross Variety

TREATMENT	Yield Per Acre	Corrected Yields	Difference Due to Treatment
	bu.	*bu.*	*bu.*
Check	212.7	......	......
Bordeaux Mixture, 5-5-50	294.7	220.1	74.6
Bordeaux — Kayso	259.2	227.5	31.7
Copper-lime Dust	224.6	234.9	—10.3
Check	242.4	......	......
Bordeaux Mixture, 5-5-50	275.0	236.5	38.5
Bordeaux — Kayso	297.0	230.8	66.2
Copper-Lime Dust	237.9	225.1	12.8
Check	219.4	......	......
Bordeaux Mixture, 5-5-50	248.1	219.0	29.1
Bordeaux — Kayso	275.7	218.6	57.1
Copper-Lime Dust	225.9	218.2	7.7
Check	217.8	......	......

Spraying Tests with Late Crop Potatoes

As in previous years, spraying tests were conducted with late-planted potatoes grown from seed. In one of these tests conducted on the Frank Jones farm, at Freehold, considerable tip-burn and some early blight appeared, and resulted in the early death of the vines on the unsprayed plots. On plots sprayed with Bordeaux mixture the vines remained green until harvesting time. In this test 4 spray applications were made in all, on the following dates: September 6, 14, 25 and October 13. The plots were dug October 30 and the yield of each obtained. These are shown in table 6.

From the table it will be observed that in every case the plots sprayed with Bordeaux mixture outyielded those unsprayed. The average yield of the check plots was 110.2 bushels per acre as compared with 137.1 bushels for those sprayed with Bordeaux mixture.

TABLE 6

Arrangement of Plots and Yield Per Acre of Spraying Test With Late Crop Irish Cobblers (Frank Jones Farm)

TREATMENT	Yield, Per Acre	
	A	B
	bu.	*bu.*
Check	101.1	116.0
Bordeaux Mixture, 5-5-50	131.2	138.0
Check	105.2	99.0
Bordeaux	137.1	142.1
Check	124.1	116.1

Spraying Test in Cooperation with J. H. Kandle

In the spray test conducted with late crop Irish Cobblers on the J. H. Kandle farm at Elmer, a comparison was made of Bordeaux mixture prepared with stone and hydrated lime. In the former case a 5-5-50 formula was used, while in the latter the amount of lime was increased to 75 pounds. The spray applications were made on September 10, 19, 27 and October 12. There was included also a series of plots sprayed with 10-10-50 Bordeaux mixture prepared with stone lime. These plots received only 2 applications, made on September 10 and 27. During the season little difference was noted between the plots receiving the various treatments; in every case, however, they were superior to those unsprayed. On the latter plots tip-burn was quite severe, and some injury was apparent also from early blight and leaf hoppers. The plots were harvested on October 31. The arrangement of the plots and the yield per acre is shown in table 7. It will be seen from the table that, with the exception of plot 4, sprayed with Bordeaux mixture prepared with hydrated lime, the yields of the different treated plots were quite uniform. The average yield of the unsprayed plots was 91.6 bushels, of those sprayed with Bordeaux prepared with stone lime 116 bushels, of those with Bordeaux prepared with hydrated lime 126 bushels, while the lots sprayed with the 10-10-50 mixture yielded at the rate of 113 bushels per acre. While the control of the diseases was, approximately, as efficient on the latter plots as on those sprayed with

the 5-5-50 mixture, no definite conclusions can be drawn, since the arrangement of the plots was not satisfactory, and, in addition, there was little rainfall to wash the spray material from the leaves. The results secured are quite promising, however, and the work is being continued.

TABLE 7

Arrangement of Plots and Yield Per Acre in Spraying Test With Late Crop Irish Cobblers (J. Harry Kandle Farm)

TREATMENT	Yield Per Acre
	bu.
Check	109.0
5-5-50 (Stone lime)	117.0
10-10-50	107.0
5-5-50 (Hydrated lime)	145.0
10-10-50	119.0
5-5-50 (Stone lime)	115.0
Check	82.0
5-5-50 (Hydrated lime)	107.0
Check	84.0

Summary

1. Despite the fact that the season of 1923 was exceptionally dry and *unfavorable generally for the production of a maximum crop of potatoes*, increased yields followed in all of the spray tests with both the commercial and late crop.

2. In one spray test with the Irish Cobbler grown as a commercial crop, a commercial Bordeaux mixture gave slightly greater returns than home-made Bordeaux.

3. The use of Kayso as a sticker and spreader in Bordeaux mixture did not increase its fungicidal value or sticking qualities; due probably to the fact that the season being very dry, little of the Bordeaux mixture was washed from the vines.

4. In a second spray test with the Irish Cobbler variety, Bordeaux mixture, with and without Kayso, gave excellent control of flea beetles, while very little control resulted from the use of copper-lime dust. In this test also, the latter material failed to control tip-burn, hopper-burn and early blight, while good control followed the use of Bordeaux mixture.

5. In a test with the American Giant variety grown as a commercial crop 8 applications of Bordeaux mixture gave an average yield increase of 24.3 bushels per acre. In the same field on plots where the first 4 applications were omitted, a yield increase of 18.4 bushels resulted.

6. In a test with the Norcross variety grown as a commercial crop, plots dusted with copper-lime dust were little better than those receiving no treatment. On the other hand, adjoining plots sprayed with Bordeaux mixture remained green until late in the season and gave an average yield increase of 13.2 bushels per acre over the dusted plots.

7. In a spray test with late crop Irish Cobblers, 2 applications of a 10-10-50 Bordeaux mixture gave a yield increase equal to that resulting from 4 applications of a 5-5-50 mixture. In this same test the increase resulting from the use of Bordeaux mixture prepared with hydrated lime was equal to that obtained where stone lime was used.

OATS SMUT CONTROL STUDIES

WM. H. MARTIN

During the past year the department cooperated with the Crop Protection Institute in a cereal seed treatment project, the object of which was "to determine the effect of chemical dusts on the amount of smut and on the yields of wheat, barley and oats, and to compare the general effectiveness of the dusts with that of copper sulfate and formaldehyde." The test conducted by the department was restricted to oats alone.

The following methods were followed in treating the seed:

1. Copper-sulfate dip.—Soaked for 10 minutes in a solution of $CuSO_4$ 1 lb., salt 1 lb., water 5 gal. Then for 10 minutes in milk of lime, 1 lb. stone lime in 10 gallons of water.
2. Formaldehyde sprinkle.—Seed thoroughly sprinkled with solution of 1 pint of formaldehyde in 40 gal. water. Covered 4 hours.
3. Formaldehyde spray.—Seed sprayed with a solution of 1 pint water to 1 pint of formaldehyde. Covered 4 hours.
4. Copper-carbonate dust.—2 oz. per bu. of seed. (All dust treatments were made by placing the seed with the required amount of dust in a bottle and shaking until thoroughly covered).
5. Nickel-carbonate dust. 2 oz. per bu.
6. Semesan. 2 oz. per bu.
7. Kalimat. Seed soaked 30 minutes in 0.25 per cent solution.
8. Sulfur. 4 oz. per bu.
9. Dehydrated copper-sulfate and lime. Equal parts used at rate of 1 oz. per. bu.
10. Aluminum Sulfate 2 oz. per bu.

In all cases the treatments were made on the morning of April 30, and the treated grain was planted in the afternoon of the same day. In planting, each row was made 110 feet long, and 3 rows made up a plot. Each treatment was repeated twice, and the arrangement of the plots was such that a check plot, planted with untreated seed, alternated with 3 treated plots. In making smut counts and obtaining yield data the 110-foot plots were divided into 3 plots each 30 feet long, so that each treatment with its check was replicated 6 times.

Influence of Treatment on Germination

Tests were conducted in both blotters and soil to determine the influence of the various treatment on the germination of the seed. The former were conducted by the seed analyst of the experiment station; the latter were conducted in flats containing soil from the field in which the test was conducted. The seed was not planted in the flats until May 1, so that all of the seed treated by the wet treatments had dried out. Germination counts on the 300 seed planted were made when the first plants were visible, and again at daily intervals, until no further germination was recorded. The results of the tests in both blotters and soil are shown in the figures of table 8.

TABLE 8

Influence of Seed Treatment on Germination of Oats

TREATMENT	Germination in Blotters	Germination in Soil					
		May 8	May 9	May 10	May 11	May 12	May 16
	*per cent**	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
Copper-Sulfate Dip	90.0	20.2	66.0	80.6	82.6	90.6	96.6
Formaldehyde Sprinkle	98.0	33.5	74.0	88.3	88.6	93.6	96.3
Formaldehyde Spray	98.0	22.6	63.0	81.0	87.0	92.3	96.3
Copper-Carbonate Dust	98.0	19.0	61.6	76.3	80.6	89.0	97.0
Nickel-Carbonate Dust	96.0	33.6	76.6	89.0	90.6	94.6	98.0
Semesan	90.0*	28.6	75.6	85.0	89.0	95.3	98.3
Kalimat	94.0	22.0	64.3	84.3	88.0	92.6	97.0
Sulfur	98.0	24.0	70.0	85.6	87.3	94.0	97.3
Dehydrated Copper Sulfate and Lime	100.0	15.3	62.6	80.0	83.0	92.0	96.6
Aluminum Sulfate	98.0	12.0	56.6	77.6	86.0	91.6	96.0
Check	98.0	15.6	61.0	75.0	80.6	88.3	93.3

*Vitality impaired.

On July 2 counts were made on the center row of each plot to determine the per cent of smut. When the crop had matured, the center row of each plot was harvested and the weight of grain obtained. The per cent of smut in each treatment, as well as the yield of grain, is shown in table 9. The figures in the table represent the averages of 6 replications of each treatment and the check plots.

TABLE 9

Influence of Seed Treatment on Per Cent of Smut and Production of Grain and Straw

TREATMENT	Smut	Yield of Grain per acre
	per cent	*bu.*
Copper-Sulfate Dip	0.28	23.9
Formaldehyde Sprinkle	0.16	25.1
Formaldehyde Spray	0.32	25.9
Copper-Carbonate Dust	0.85	25.4
Nickel-Carbonate Dust	0.22	26.4
Semesan	3.93	25.7
Kalimat	1.06	25.0
Sulfur	1.14	25.6
Dehydrated Copper-Sulfate-Lime	1.17	22.9
Aluminum Sulfate	2.49	25.1
Check	4.13	24.6

Best control of smut was had in the lot of seed treated by the formaldehyde-sprinkle method, while the results by the copper-sulfate dip and the formaldehyde-spray methods were, approximately, as good. It is interesting to note, however, that the control of smut resulting from the use of nickel carbonate was nearly equal to that resulting from the formaldehyde-sprinkle method, and also that, where copper carbonate was used, very satisfactory control of smut followed. From a consideration of the yield data, it will be seen that, with the exception of the copper-sulfate dip and hydrated copper-sulfate-lime treatments, all of the treated plots gave an average yield greater than that of the check plots.

SWEET POTATO DISEASE STUDIES

R. F. Poole

Since the autumn of 1920, some very favorable results have been obtained in reducing losses caused by stem rot, ground rot and scurf diseases of sweet potatoes in New Jersey. Experiments on the control

of these diseases have been continued in order to determine if the diseases can be completely controlled and eradicated from all soils, as well as from the seed potatoes.

The outstanding results obtained in the control of scurf caused by *Monilochaetes infuscans* and "Pox" caused by *Cystospora batatas* are given in this report. Since the results obtained in the studies on the control of stem rot, caused by *Fusarium hyperoxysporium* and *Fusarium batatatis* are published in bulletin 401, they will be omitted in this report. In this bulletin the principal commercial varieties and also strains of Jersey varieties are compared, in which some are shown to be more resistant to stem rot than others. The results will be of some interest to those who are not now troubled with stem rot as well as those who have severely infected soils, since it is also shown that some Jersey strains and some varieties are more productive than others.

Pox or Ground Rot Disease Studies

The pox or ground rot disease of sweet potatoes, caused by *Cytospora batatas E.* was worse in 1923 than during any of the three preceding seasons. On some farms the crop was a total loss. In many fields serious infection was observed in June on plants that were set between May 15 and June 1. The early infection stunted the growth of a very large number of plants in spots throughout the field. The most severely injured plants were unproductive of salable potatoes. In fields where infection took place in late summer, the yield was not severely reduced, but many of the potatoes were marked, causing poor quality.

Since the infection was observed at a much earlier date in the dry season of 1923 than in the wet of 1922, it seems quite reasonable to believe that moisture and temperature conditions have much to do with the development of the disease. In 1922 there was only a slight trace of pox infection observed in the experimental plots at Vineland, but in 1923, while infection was slight in much of the field, it was very serious on plots in the field where clay came to the surface. The same condition was observed on Eastlack's farm near Swedesboro, some areas were more severely infected than others, and infection in the whole field was more serious in 1922 than in 1923.

Experiments for the control of the disease were conducted in Gloucester and Cumberland Counties. Sulfur was previously found to be effective in reducing the pox disease, but in some fields the results had been very irregular. In dry seasons it was less effective than in wet seasons. In order to determine the factors governing the irregular effectiveness of the compound, it was used more extensively and in larger amounts per acre than in the past. Lime promoted the disease in nearly all tests, but it was used in order to study what effect it would have under normal, wet and dry conditions. The sulfur and lime were applied broadcast just previous to planting in May. The size of the plots was $^1/_{46}$ acre, and each treatment was repeated one or more times.

The results of tests conducted on Eastlack's farm near Swedesboro are given in table 10. The data given is an average of 3 or more replications of each treatment. In these tests 300 pounds of inoculated sulfur gave the best results. This amount did not reduce the per cent of infection as much as the larger amounts of sulfur, but the latter caused injury, which resulted in a lower yield than was obtained on the 300-pound plots. On the plots treated with lime the percentage of pox marked potatoes was much higher, and the yield much lower than on the sulfur and untreated plots.

TABLE 10

Results of Soil Treatment for the Control of "Pox" on Eastlack's Farm Near Swedesboro

TREATMENT	Amount	Pox Infection	Yield per Acre
	lbs.	*per cent*	*bushels*
Check	....	62.7	66.4
Sulfur	300	32.7	123.2
Sulfur	400	36.8	87.3
Sulfur	500	28.1	66.2
Sulfur	600	23.4	33.9
Sulfur	800	29.3	23.1
Lime	1000	73.9	45.8
Lime	1500	94.1	15.3
Lime	2000	91.8	13.3

The results of tests conducted on Staten's farm near Swedesboro are given in table 11. The plan of the experiment is similar to that described above. In the field where this test was conducted the loss was frequently very small, but many of the sweet potatoes were marked. This was different from the condition noted in many fields where the disease caused an early stunting of the vines, which resulted in a very poor yield. The number of marked potatoes was smaller where the high amounts of sulfur was applied than where 300 and 400 pounds were added. The 400-pound application was nearly as effective as the 500 and 600-pound applications in reducing the number of poxed potatoes, and was much more effective than the 300-pound application. In reducing the disease, the sulfur was also a means of increasing the yield. On some plots, especially the 500 and 600-pound plots, the sulfur caused some injury, which lowered the yield.

At the Vineland training school tests have been conducted with lime and sulfur mixed with fertilizers and broadcast in the row just before resetting the sweet potato sprouts. The treatments were applied first in 1922 and again in 1923. The Vinleand strain of the Yellow Jersey was grown on the plots. The plants were set by machine 18 inches apart in rows 3 feet apart. The average results of 3 replications of each treatment are given in table 12. Pox infection on

PLATE 4

Sweet potato disease studies. The center area shows vines severely stunted by the Pox disease. Adjacent vines were not severely injured and produced a fair yield.

PLATE 1

Sweet potato disease studies. The center area shows vines severely stunted by the Pox disease. Adjacent vines were not severely injured and produced a fair yield.

TABLE 11

Results of Soil Treatment for the Control of "Pox" on Staten's Farm Near Swedesboro

TREATMENT	Amount	Pox Infection	Yield per Acre
	lbs.	*per cent*	*bushels*
Check	....	54.4	199.6
Sulfur	300	31.7	224.2
Sulfur	400	18.5	213.3
Sulfur	500	14.2	180.7
Sulfur	600	16.2	232.5

TABLE 12

Results of Soil Treatment for the Control of "Pox" on the Vineland Training School Farms

TREATMENT	Amount	Pox Infection	Yield per Acre
	lbs.	*per cent*	*bushels*
Sulfur	100	1.7	207.4
Sulfur	200	1.6	195.5
Sulfur	400	0.3	266.2
Lime	2000	43.7	159.3
Lime	3000	15.7	165.9
Check	....	36.7	145.7

untreated and lime plots was heavy, but it was slightly irregular in different parts of the field. The infection was very slight on the plots treated with sulfur, even the 100-pound application was very effective in controlling the disease. These results indicate that sulfur can be mixed with fertilizers and the two applied together. Since the results are more positive where sulfur was applied on the same land 2 years in succession than where it was applied the first year, it is advisable to make small applications every year for 2 or 3 years rather than apply 400 or 600 pounds per acre in any one year. The adoption of this method may result in greater yield, such as that shown in the above test, in which the production on the sulfur plots was 25 to 121 bushels larger than that of the untreated and limed plots.

Isolation Studies

The data obtained from field experiments show that the disease can be reduced by economical measures. More accurate data than has been reported on the control of the disease could possibly be worked

out with a pure culture of the casual organism and other organisms associated with it, which are not known to be established in pure culture at the present time. In order to have fresh-infected material during the winter months for isolation study, infected soil was obtained at Mickleton, and the Triumph and Yellow Jersey varieties were continually grown in it in the greenhouse, where infected roots were available throughout the winter. Parts of roots with infected areas were prepared in several way for making cultures. Some sections were emersed in 1-1000 mecuric chloride solution, ranging from 2 to 5 minutes, rinsed in sterile water, and plated in petri dishes or tubed. After being sterilized, some sections were crushed in a sterile mortar and plates were poured using several dilutions. The culture media were made with sweet and Irish potato extracts and with chemicals.

Although many pox-infected parts of roots were used at various times from December to April in these studies, the results of isolating the causal mixomycete were negative. Species of bacteria, fungi and actinomyces were isolated. Some of them were constantly present, especially a few strains or species of actinomyces. Sweet potato roots will be inoculated with those species of fungi and actinomyces that were so frequently isolated from the poxed spots, in order to determine if they are associated in any way with the causal organism.

Varietal Resistance

A large number of the important commercial sweet potato varieties were grown in pots in infected soil in the greenhouse. The results showed that roots of the Red Brazil, White Yam, Porto Rico, Nancy Hall and other varieties were not so severely poxed as the Red Jersey and Yellow Jersey strains. Since the production of edible roots in the pot cultures was very irregular, this test does not indicate what effect the disease will have on the yield of the different varieties when grown on the severely infested soils. In order to determine the order of resistance, a number of varieties will be planted on infected soil in Gloucester County.

Studies on the Control of the Scurf, or Soil Stain Disease of Sweet Potatoes

The laboratory investigations have consisted of isolation, inoculation and culture studies. The fungus, *Monilochaetes infuscans, E. & H.*, was isolated from sweet potatoes collected in several localities of the state. Inoculation tests were conducted on the Yellow Jersey sweet potato to determine whether any of the isolations of the fungus produced biological strain differences, or if it was the same in all localities of the state. The inoculation results were positive, but as yet no strain distinctions were made, and the degree of virulence seemed to be the same.

In previous experiments it was shown that scurf sometimes spread in storage houses, in which the air was kept fairly dry. Observations in the field also indicated that it was worse in heavy soils, especially those that contained much organic matter, such as barnyard manure, than on those light soils deficient in organic matter. It was also seen that the potatoes were more severely scurfed in wet seasons than in dry seasons. In order to make a thorough investigation of the points brought out in the above discussions, some experiments were started with moisture cultures in the laboratory. The tests were conducted in coarse white sand, which had previousley been found to be an excellent medium in which to carry out inoculation tests with the scurf fungus. Distilled water was added to the sand in glazed earthenware quart pots, making moisture cultures 0, 3, 6, 8, 11, 14, 17, 20, 23, and 26 per cent, the saturation point being 26 per cent. The loss due to evaporation was replaced at frequent intervals, from 2 to 3 days. Disease-free Yellow Jersey sweet potatoes, after being dipped 10 minutes in a 1-1000 mercuric chloride solution, were inoculated and smeared on opposite sides with a pure culture of *Monilochaetes infuscans*, which was sporing abundantly. Two inoculated and one uninoculated potato of very nearly equal size were placed in each pot, but separated from each other and covered with a layer of sand. The tests were conducted in a laboratory where the temperature varied only slightly from 20 to 24° C. The inoculations were begun Febuary 18 and terminated April 1, but frequent examinations were made between these dates. The results of the test showed that the potatoes sprouted well in the moisture range from 14 to 26 per cent, but there was much soft-rot decay in the high moisture pots, which was not observed in the low ones. The sprouts were abundant and ranged in length from 1 to 4 inches in the 14 to 26 per cent range of moisture. Only slight sprouting occurred in the 3 per cent moisture cultures. The development and spread of the disease on individual infected potatoes were also more definitely pronounced between 14 and 23 per cent of moisture than in the saturated and nearly dry cultures. In some of these cultures the potatoes were completely blackened by the disease in a period of 6 days. Infection took place in the saturated cultures and was also very slight in the 3 and 6 per cent cultures. The uninoculated potatoes remained healthy. These results indicate that the spread of scurf is likely to be checked in dry weather, resulting in less mottling of the potatoes than during wet seasons, when conditions are more favorable for a continual spread of the fungus throughout the period in which the potatoes are formed. These tests indicate that bedding even slightly infected sweet potatoes in a warm and moist plant-bed is ideal for the spread of the disease on individual potatoes, which may result in greater sprout infection. The use of clean seed in a clean plant-bed may insure sprouts free from scurf. The results also indicate that further studies on this subject may yield some very interesting results.

Culture Reaction on the Growth of Monilochætes Infuscans

In order to determine the rate of growth of *Monilichaetes infuscans* on media adjusted to various hydrogen-ion and hydroxl-ion reaction, a series of tests was conducted on Cook's synthetic medium, in which the potassium acid phosphate and magnesium sulfate were increased from 0.25 to 1 gram, and on sweet potato extract, which was obtained by cooking 300 grams of peeled Yellow Jersey sweet potatoes in 1000 cc. of distilled water, and straining through a heavy cloth. The culture media were prepared in 50-cc. amounts in 250 Erlenmeyer flasks, but finally made up to 90 cc. after the pH was adjusted to 3.0, 3.5, 4.0, 4.6, 5.1, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0 and 9.0. These reactions were made colometrically with indicators described by Clark and Lubs. The flasks were inoculated with spore suspensions on January 18 and maintained at 25° C.

The results of the test on both media showed that the fungus did not germinate or grow at a pH 3.2. The germination was very slight and the growth very poor at a pH 4.0. The maximum growth was obtained near the neutral point, although excellent growth was obtained in the lightest alkaline cultures, showing that an alkaline medium is much more apt to promote the development of the fungus than is an acid one. The character of fungous growth is also influenced by the various reactions, and inoculation tests will be conducted later to determine the degree of virulence of the fungus as it grows in each reaction.

Field Studies of the Control of the Scurf Disease of Sweet Potatoes

The scurf disease was less prevalent in 1923 than in 1922. There was none or only slight infection of sweet potatoes in some fields where scurf was serious the year before. In a large number of fields the stems of the plants were infected, but the disease had not spread to the potatoes by digging time, indicating that the dry season was less favorable for the development and spread of the fungus than the wet season of 1922. In order to continue to study the effects of sulfur and lime on the crop and the disease, tests were conducted on several farms. Tests were conducted with inoculated commercial sulfur and hydrated lime. These were broadcast on the field after the furrow rows were opened. Some results of tests conducted on the farm of J. I. Little, of Forest Grove, are given in table 13.

The results show that sulfur was effective in controlling scurf. Besides the reduction of infection on the salable-size potatoes, there were 1, 7, 18, 27 and 25 scurf-free hills out of a possible 30 on the untreated, 200, 300, 400 and 500-pound sulfur treatments per acre, respectively. The factors influencing the control of scurf in the soil are probably many, and are not yet fully understood.

While the soil on the sulfur treated plots was more acid than it was on untreated plots, and there was very little infection on the heavy sulfur treated plots in comparison to the highest percentage of in-

fection on the weaker treatments, the colorimetric determinations of the soil from all plots indicated that control was probably influenced by other factors not yet detected as well as by an acid reaction.

A similar test was conducted on the farm of Felix Donata, of Landisville. Some of the results are given in table 14. They show that sulfur reduced the disease on the salable sized potatoes, but was less

TABLE 13

Some Results of Tests Conducted on the Control of Scurf of Sweet Potatoes on the Farm of J. I. Little

TREATMENT	Amount per Acre	Potatoes Scurfed	Yield per acre
	lbs.	*per cent*	*bu.*
Check	....	89.2	246.6
Sulfur	200	60.5	236.6
Sulfur	300	22.0	286.6
Sulfur	400	5.8	290.6
Sulfur	500	9.6	270.6

TABLE 14

Some Results of Tests Conducted on the Control of Scurf of Sweet Potatoes on the Farm of Felix Donata

TREATMENT	Amount per Acre	Potatoes Scurfed	Yield per acre
	lbs.	*per cent*	*bu.*
Check	....	72.6	93.3
Lime	1000	84.3	85.5
Sulfur	300	37.8	125.5
Sulfur	400	39.8	107.6
Sulfur	500	16.4	101.1

effective than it was in the soil in the test at Little's. Lime promoted the disease. There were 30, 32, 10 and 13 scurf-free hills out of a possible 35 on the untreated, limed, 300 and 500 pounds sulfur per acre plots, respectively. On the untreated and limed plots the potatoes, especially the largest potatoes, were mostly severely blackened. Although the percentage of scurf infection was sometimes high on the plots treated with small amounts of sulfur, none of the potatoes were as severely mottled as on the untreated and limed plots. These results indicate that the development and spread of the disease were reduced where the soil was sulfured.

TOMATO DISEASE STUDIES

R. F. POOLE

During the past 3 years certain tomato diseases were worse some seasons than others. It is believed that further information on the prevalence and destructiveness of these diseases over a period of years, when compared with the weather conditions for the same period, should be of much value in aiding growers to control the diseases more economically than has been the case in the past. Our studies indicate that it is not necessary to completely control the septoria leaf spot disease in order to obtain a maximum yield of well-matured tomatoes. They do show that much of the leaf area must be preserved to prevent the ripening of immatured tomatoes. The prematurely ripened tomatoes are mostly small, yellow and of very poor quality. In order to determine the minimum number of spray applications for obtaining maximum yield results, and to get more information on the effectiveness of Bordeaux mixture on the control of fruit rots and other diseases, spraying and dusting tests were continued again this year on the Joseph Campbell Company farms at Riverton.

Some Results of Spraying and Dusting Early Bonny Best Tomatoes

Spraying and dusting experiments were continued on the Joseph Campbell Company farms at Riverton. Experimental plots contained 3 rows of 160 plants each. The plants were set 3½ by 5½ inches in the row. The dust used in the test contained 20 per cent monohydrated copper sulfate and 80 per cent hydrated lime. Standard Bordeaux mixture was used in single and double strength and with 1½ pounds of fish oil soap. The treatments were given on July 5 and 19. The dust was applied with a Fenny hand duster at the rate of 41 and 54.7 pounds per acre. The Bordeaux mixture was applied with a 100-gallon, three-row, three-nozzle traction spray machine at the rate of 150 to 200 gallons per acre, with a pressure of 250 pounds per square inch. There was no noticeable injury observed following any of the treatments. The first and last tomatoes were picked on July 16 and September 11, respectively. The average yield of 3 plots of each test is given in table 15. There was no gain due to any treatment. Since the tomatoes were only slightly infected with the leaf-spot diseases, the results indicate that the treatments were of no value in the absence of heavy infection.

TABLE 15

Results of Spraying and Dusting Early Bonny Best Tomatoes

TREATMENT	Yield per acre
	lbs.
Check	13039
20-80	12284
4-4-50	13254
4-4-1½-50	13583
8-8-50	13371
8-8-1½-50	13221

Some Results of Spraying and Dusting Greater Baltimore Tomatoes

This test was conducted with the same mixtures and in the same manner as was described above. The plots consisted of 316 to 840 plants. The treatments were given on July 19 and 26 and August 8 and 20. The first and last tomatoes were picked on August 10 and October 17, respectively. The average yield of 3 plots of each test is given in table 16. All of the treatments produced larger yields than did the check plots. The yield on the dust-treated plots was much less than that produced on the sprayed plots, but larger than that of the check plots. The single strength Bordeaux mixture was as effective as the double strength in reducing infection and increasing the yield. These results indicate that the wet mixtures are more effective than the dry dust, and that the standard strength Bordeaux is just as effective as the double strength.

An estimate of the per cent of leaf-spot infection on treated and untreated Greater Baltimore tomatoes on different dates is given in

TABLE 16

Results of Spraying and Dusting Greater Baltimore Tomatoes

TREATMENT	Yield per acre
	lbs.
Check	11155
20-80	12776
4-4-50	16266
4-4-1½-50	15374
8-8-50	15824
8-8-1½-50	15822

table 17. The results were obtained by counting the total number of leaves and the infected ones on 10 average plants on treated and untreated plots. These results do not indicate the number of spots on

TABLE 17

An Estimate of Leaf Spot Infection on Treated and Untreated Greater Baltimore Tomatoes

TREATMENT	Leaf Spot Infection				
	Aug. 8	Aug. 23	Sept. 4	Sept. 14	Oct. 10
	per cent	*per cent*	*per cent*	*per cent*	*per cent*
Check	2.5	22.0	45.0	97.5	100
20-80	2.9	14.0	37.0	66.0	95
4-4-1½-50	3.0	3.1	6.5	8.0	62
4-4-50	2.6	3.0	7.5	15.0	70

infected leaves, but where infection was serious, the spots were sometimes very abundant, especially on the lower leaves. For instance, the vines on check plots were nearly defoliated by September 14, when there was an average infection of 97.5 per cent of the leaves. After spraying was discontinued, the vines on sprayed plots gradually became infected as the mixtures were washed from the plants. Since much of the crop was harvested before October 10, a late heavy infection, such as occurred at this time, was of no economic importance.

Hail Injury and Tomato Rots

On June 24 and July 22, hail storms caused much injury to tomatoes in the vicinity of Riverton. The vines and leaves were badly broken, and the tomatoes were punctured by the stones. The injured parts on vines and leaves became dry and white after a few days. Although the injured parts were favorable sources for infection, none of the bacteria and fungi parasites of the tomato plant were observed on the injured plants. Three days after the hail storms nearly all of the injured ripe tomatoes were decaying. Some of the green and partly ripened tomatoes were also rotting. In some cases injured tomatoes became infected and rotted after they ripened. A quantity of Bonny Best tomatoes in the process of decay was collected August 8, and pure cultures of bacteria and fungi found on the injured parts were obtained for identification. *Rhizopus* sp., *Fusaria* sp., *Macrosporium solani*, *Oidium oospora lactis* and *Bacillus carotovorus* were most prevalent organisms. Of this number, *B. carotovorus* caused the most serious loss. The results of examining hail-injured tomatoes and the identification of organisms associated with their decay

are given in table 18. The first 100 plants examined were Greater Baltimores, and the last 100 Bonny Bests. The tomatoes examined represent both green and ripe fruit. Sometimes there were two or more different organisms obtained from a single tomato. *Bacillus carotovorus* caused rapid decay, and prevented the development of fungi on tomatoes it attacked. *Oidium oospora lactis* also caused rapid decay, and the white fungus was generally very prominent on the affected parts. The *Fusaria* sp. and *Macrosporium solani* fungi were sometimes associated, and they produced a slow dry rot. The *Rhizopus* sp. caused rapid decay, and the characteristic sporing of this fungus was always very prominent.

TABLE 18

The Results of Examining Hail-injured Tomatoes and the Identification of Organisms Associated With Their Decay

Plants *Examined*	TOMATOES						
			Affected with:				
	Examined	Decaying	*Rhizopus* sp.	*Fusarium* sp.	*Macrosporium solani*	*Oidium oospora lactis*	*Bacillus carotovorus*
100	1810	270	20	50	60	40	170
100	1630	290	40	20	90	30	190

PEA ROOT ROT STUDIES

C. M. HAENSELER

Previous studies on the pea root rots in New Jersey have shown that there are a number of types of this disease, each with specific characteristics and each caused, presumably, by some specific organism. The economic importance of these root rots in the state has been recognized for some years, but the relative importance of the various forms of the disease and the specific organisms responsible for each has remained undetermined. Studies to determine the cause and relative importance of these root rots and to devise control measures were begun in a small way in 1921 and continued during the past year along the following lines:

(1) Studies on organisms associated with the various types of root rot.
(2) Tests of pathogenicity with the isolated organisms.
(3) Influence of soil moisture on certain of the root rot organisms.
(4) Influence of plant age on susceptibility to certain of the root rot fungi.
(5) Influence of repeated plantings in soils infected with certain root rot organisms.
(6) Influence of fertilizer, lime and sulfur applications and methods of fertilizer application on development of root rot.
(7) Influence of various planting depths on development of root rot.
(8) Selection for resistance to root rot and tests of resistant strains.

Associated Organisms

Isolations made from a large number of roots and underground parts of pea stems showing various forms of root rot have in a majority of cases yielded species of Fusarium, as in previous years. Very frequently these were accompanied by a species of Phoma or by *Ascochyta pisi,* and not infrequently these latter fungi were obtained in pure culture unaccompanied by Fusarium. From one specific type of root and stem rot, a type very destructive to the plants attacked, but of minor importance as a field disease, *Rhizoctonia solani* was invariably obtained. Results of studies on this disease were given in the 1923 report of the New Jersey Agricultural Experiment Station. During the past year a species of Pythium has also been obtained repeatedly from root rot specimens and from seed which failed to germinate in field plantings. Since Pythium has been named as one of the fungi responsible for pea root rot in other states, this organism was given careful study, the results of which are presented later in this report.

Another and more destructive form of root rot occurs in the light sandy soils in portions of Cumberland, Burlington and Camden Counties. Typical diseased specimens of this type show a softening of the cortex of all below-ground parts with a gradual browning of the diseased tissues. The browned cortex passes through a soft, somewhat water-soaked stage, finally collapsing and almost disappearing. In the last stage of the disease all underground parts of the plant undergo decay with the exception of the hard woody central cylinder, which remains unaffected by the disease. Isolation from plants showing such symptoms have yielded a variety of fungi, with Fusarium, Phoma, Ascochyta, and occasionally Pythium predominating, but none of these was obtained with sufficient regularity to suggest it as the causal organism. More uniform results were obtained by microscopic examinations, which showed that in every typical case of soft cortex rot of underground parts the rotten tissue was filled with oospores of a fungus apparently identical with *Aphanomyces euteiches,* a new species recently described by Charles Drechsler (unpublished data) as causing a root rot of peas in Wisconsin. As repeated attempts to isolate this organism have so far met with failure, it is impossible at this time to make absolute statements as to the identity and parasitic nature of the oomycete found in the New Jersey material, but its constant association with the typical soft, brown, root rot would strongly suggest that this fungus is causing the most serious type of root rot in New Jersey.

Pathogenicity Tests

Of the many organisms isolated from root rot material, 14 species or strains most constantly associated with the disease were tested during the past year for pathogenicity by pure culture inoculations in sterilized soil. Of these 14 isolations, 11 were strains of Fusarium; 1 was a sterile fungus and 2 were strains of Pythium. One of the strains of Fusarium (F 26) and the sterile fungus (F 28) were shown to be a parasitic on peas in earlier experiments (New Jersey Experiment Station Report, 1923), but the other 12 isolations were tested for the first time this year.

Of the 11 strains of Fusarium tested, 10 failed to give infection except for a silght browning on a few plants, and are not regarded as parasitic on the pea. One strain of Fusarium (F 26) and sterile fungus (F 28), the same cultures which proved parasitic in 1923, again gave successful inoculations, but the results were less satisfactory than in the previous year. These 2 fungi were used in a number of tests which will be discussed later in this report, and from which will be seen their weak parasitic nature. These 2 fungi (F 26 and F 28) grown on steamed rice were also used to inoculate 50-foot rows of peas under field conditions, but no infection resulted. Since these same organisms gave practically 80 to 100 per cent infection in a number of tests in 1923, it is probable that the poor infection this year may have been due to the long artificial culturing of the parasite or to the low night temperature (48° to 52° F.) which prevailed throughout the course of these experiments. These organisms will be tested further in the future.

The two strains of Pythium isolated from peas and a strain isolated from spinach gave more satisfactory results and proved to be very active parasites on the pea. Since these three strains were identical microscopically and acted similarly in a number of inoculation experiments, they will be considered as one species and discussed together. A number of tests were conducted to determine the parasitic nature of this Pythium, and in all cases the results were decidely positive, except in the case of one experiment consisting of 24 water cultures, where inoculation of submerged roots failed to give infection.

Pea-vine cuttings with the bases placed in test tubes containing water and inoculated with pure cultures of Pythium began to rot within 24 hours. After 4 days all inoculated plants were slimy with a soft rot, while check plants were still sound. Spinach leaves in moist chambers were also rapidly decayed by this organism, while uninoculated leaves remained firm. Pea seed were also readily attacked. Swollen seed placed in petri dishes and inoculated on the surface with pure cultures of Pythium all broke down with a soft rot within a few days, most of the seed rotting before germination started. Seed germinated in petri dishes and inoculated after the radicals were well developed also rotted within a few days.

In order to further test the importance of this Pythium as a parasite on peas, a number of inoculation experiments were conducted in steam sterilized soil under greenhouse conditions. In a prelimnary test all the seeds in the inoculated pots rotted before germination, while in the check pots germination was perfect. In soils maintained at 60 to 80 per cent saturation and inoculated with young agar cultures of Pythium, every seed rotted before germination, but in drier soils the organism was much less virulent.

From the results of field observations and these experimental tests it is apparent that Pythium is an active parasite on the pea, especially on the ungerminated or germinating seed, and it seems very probable that a large amount of the pea seed and seedling rot which occurs in cool, wet springs, and especially on reavy wet soils in this state, may be due to this organism. Pythium has also been observed, both in the pot tests and in the field, to cause a stem cankering just below or just above the ground level, and also a root rot resembling that caused by Rhizoctonia, but these forms of the Pythium disease seem to be of minor importance in the New Jersey pea fields.

Influence of Soil Moisture and Soil Type on Root Rot

It has been the general experience in New Jersey that losses from pea root rot are greatest in dry season and on dry soils of light texture, notwithstanding the fact that the Aphanomyces species, which is so constantly associated with our most destructive form of root rot, requires a wet soil for its best development. This apparent contradiction may be due, however, to the peculiar characteristics of the Aphanomyces root rot. A close study of this disease has shown that crop losses are not necessarily proportional to the amount of infection. This is brought out quite clearly by a comparison of the damages caused by this disease in 1923 and 1924. In 1923, a very dry year, in some fields in Burlington and Camden Counties in which 100 per cent of the plants were diseased, the crop was a total failure, whereas in 1924, a very wet season, fields on these same farms, and where 100 per cent of the plants were again diseased, yielded approximately 50 to 75 per cent of a normal crop. It is a characteristic of the Aphanomyces root rot to destroy the cortex of all below-ground parts and to leave the water-conducting, or xylem, elements intact. In a wet soil, and especially if infection occurs after the plant is near the blossom stage, this woody central cylinder is able, even in the absence of a living cortex on the underground parts of the stem, to supply sufficient moisture to the growing parts to mature a fair crop. In a dry season or on a dry soil, on the other hand, such plants suffer so severely from lack of moisture that they dry up and die before the pods are filled. Besides this relationship between moisture and the effects of the root rot there seems to be some correlation between soil texture and the development of the causal organism itself.

In the Cedarville section, where 150 to 200 acres of canhouse peas are planted annually, the soil is of a sandy loam or a gravelly loam with a clay subsoil. In this section only one field was observed where root rot was very severe, and this on a plat of soil where peas had been grown continuously for 7 years, and in this case, in spite of the fact that the roots and cortex of the underground parts of every plant were rotted, a good crop was harvested. On the sandy loam fields a small amount of root rot was found throughout this section, but on the gravelly fields with clay subsoils only a few diseased plants were found. In the Bordentown section, where approximately 200 acres of canhouse peas are grown annually in a 3-year rotation on a rather heavy loam, only a trace of root rot was found.

In those sections where peas are grown for the early market the crop is usually planted on a very light sandy soil in order to insure early maturity. After the appearance and spread of the root rot, however, many of these early soils gave almost complete failures year after year, while in these same sections soils of a heavier type continued to yield fair returns. As a consequence there has been a tendency within the past few years to grow peas on soils somewhat heavier than was the earlier practice. Another result of this apparent relationship between soil texture and pea root rot has been to shift the pea growing industry to a considerable extent. For example, the pea acreage in Burlington County, where the soil tends toward the sandy, has been gradually decreasing year after year, while in Middlesex, on a somewhat heavier soil type, the acreage has increased proportionately. How far this relative freedom from root rot on the heavier soils may be due to a lack of soil infection cannot be stated as yet, but the evidence seems to be quite strong that on the heavier soils with a clay subsoil the root rot spreads less rapidly and causes less damage than on a light sandy soil.

A number of tests were conducted in pot cultures with controlled moisture in order to study the relationship between soil moisture and the various root rot organisms. In one experiment, out of 30 pots of sterilized soil, 12 were inoculated with a Fusarium sp. (F 26), 12 with sterile fungus (F 28) and 6 left uninoculated as checks. These pots were placed into 6 groups, with 2 pots of each inoculation and 1 check pot per group. The soil moistures of the 6 groups were held at 20 per cent, 40 per cent, 60 per cent, 40-20 per cent, 60-20 per cent and 60-40 per cent of saturation (based on dry weight), respectively. The 20, 40 and 60 per cent pots were held at approximately constant moistures by adding water daily, or every other day as required. In the other 3 groups the pots were started with a soil moisture content of 40, 60 and 60 per cent, respectively, but were not watered until the mositures had reached 20, 20 and 40 per cent, respectively. Each time the low point was reached the pots were again restored to the original moisture content.

The plants in the uninoculated pots and those inoculated with sterile fungus (F 28) all remained free from root rot regardless of the soil moistures maintained. In the pots inoculated with Fusarium

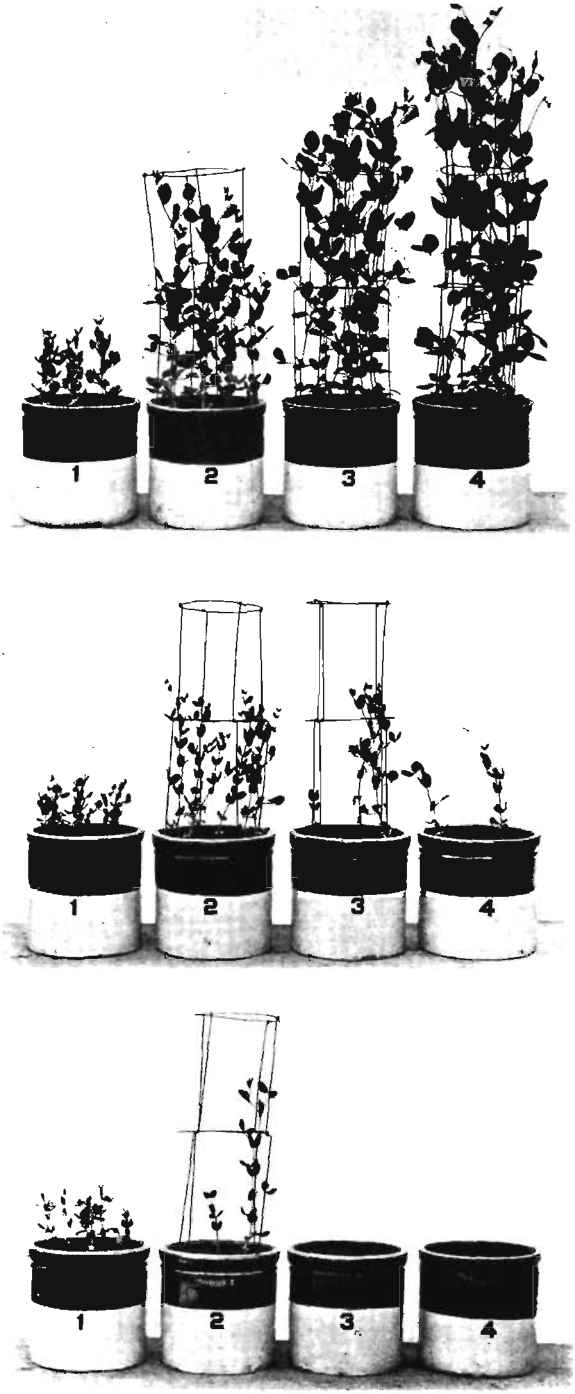
TABLE 19

Seed and Seedling Rot of Peas Caused by Pure Culture of Pythium Grown on Agar and on Sterile Pea Hay

Series No.	INOCULANT	Plot No.	Moisture	No. seed planted	No. seeds germinating normally	No. seeds with plumule rot*	No. seeds rotting before starting to germinate	No. plants in pots at time of harvest May 1*	Average height per plant
									cm.
1	Pythium F64 agar culture	1	20	9	6	2	1	8	11.5
		2	40	9	1	1	7	2	22.5
		3	60	9	0	1	8	0	....
		4	80	9	0	7	2	0	....
2	Pythium F64 Pea Hay culture.	1	20	9	8	1	0	9	11.3
		2	40	9	6	3	0	6	24.0
		3	60	9	4	2	3	4	21.7
		4	80	9	2	6	1	2	17.5
3	Check	1	20	9	9	0	0	9	15.5
		2	40	9	9	0	0	9	34.3
		3	60	9	9	0	0	9	53.1
		4	80	9	9	0	0	9	68.2

*Some plants with plumule rot succumbed while others developed secondary shoots and survived the attack.

PLATE 2



(F 26), however, an average of 30.5 per cent of the plants became infected. In the pots kept at constant moistures of 20 per cent, 40 per cent and 60 per cent, the percentage of infection was 39, 55.5 and 39 per cent, respectively. In pots with moisture fluctuating between 40 and 20 per cent and between 60 and 20 per cent, there was only a bare trace of the disease. With moisture fluctuating between 60 and 40 per cent, conditions seemed to be more favorable for infection, and 44.4 per cent of the plants developed disease symptoms.

In the case of Pythium, the influence of soil moisture on infection was more noticable than with Fusarium. This is shown in plate 2 and table 19, which give the results of a test in which pots containing sterilized soil were inoculated with Pythium grown in agar and sterilized chopped pea hay, respectively, and held at various moisture contents. It will be noted from the table that the agar culture was more virulent than the pea hay culture and that infection was greatest in wet soils. At 60 and 80 per cent soil mixture the agar inoculation caused 100 per cent rot of the seeds. In the drier soils, germination was better, but even where the seed came up, the roots rotted and growth was poor. Germination was perfect and growth excellent in all uninoculated pots.

Age of Plant and Susceptibility

To test the effect of plant age on susceptibility to root rot, peas were planted in steam sterilized soil at 7-day intervals for 6 consecutive plantings. Five pots were planted on each date. At the end of the sixth week, when the plants were, respectively, 0, 7, 14, 21, 28 and 35 days from seeding, 2 pots of each planting were inoculated with Fusarium (F 26), 2 with sterile fungus (F 28) and 1 left uninoculated. Three weeks after inoculation the plants were removed and examined. The uninoculated and the Fusarium (F 26) inoculated plants showed no signs of root rot. In the series inoculated with sterile fungus (F 28) the plants inoculated at ages 0, 7, 14, 21, 28 and 35 days showed 0, 0, 5.5, 11, 16.6 and 16.6 per cent, respectively, affected with root rot. Although the percentage of infection in this test was low, the results indicate that young plants are less susceptible to attack by the sterile fungus (F 28) than older plants.

Influence of soil mixture on growth of pea and on seed and seedling rot caused by Pythium.

Top—Steam sterilized soil.
Middle—Steam sterilized soil inoculated with pure culture of Pythium grown on sterilized pea hay.
Bottom—Steam sterilized soil inoculated with pure culture of Pythium grown on agar.

Pot 1—Soil maintained at 20 per cent of water-holding capacity.
Pot 2—Soil maintained at 40 per cent of water-holding capacity.
Pot 3—Soil maintained at 60 per cent of water-holding capacity.
Pot 4—Soil maintained at 80 per cent of water-holding capacity.

Influence of Repeated Planting

Field observations indicate very strongly that the pea root rots become more severe on soils repeatedly cropped to peas. In an effort to test this under greenhouse conditions, soil from a root rot field in Burlington County was placed into 4 boxes, 20 by 12 by 5 inches, and planted with 5 consecutive pea crops, the harvested plants being returned to the soil each time. The typical Aphanomyces root rot failed to develop, but Pythium rot of the seed and seedling, and the Fusarium root rot, which were of minor importance in the field from which this soil was obtained, continued to increase in each successive planting, the germination of these 5 consecutive plantings being 84, 65, 73, 58 and 36 per cent, respectively. After the fourth crop had been removed 4 pots were filled with some of this cropped soil, 2 of which were steam sterilized and the other 2 left unsterilized. Eight Thomas Laxton peas were planted in each pot. In the sterilized pots germination was perfect and growth normal, while in the unsterilized pots only 3 of the 16 peas planted came up and 1 of these died soon after germination.

In another test, pots of steam sterilized soil were inoculated with a pure culture of Pythium and planted with 4 consecutive plantings of peas at 10-day intervals. At the end of each 10-day period the seedlings or rotten seed were removed and another planting made. The germinations in these 4 consecutive plantings were 0, 55.5, 44.5 and 33.3 per cent, respectively, while the germination in check plots averaged 99 per cent.

Influence of Fertilizer, Lime and Sulfur Applications

In order to test the effect of the kind of fertilizer used, the method of fertilizer application and the use of lime and sulfur on the development of root rot, 25 plots of $^{1}/_{100}$ acre each were treated as indicated in table 20.

This test was conducted in cooperation with C. S. Stevens & Sons, Cedarville, N. J., and on a field which had been in peas almost continuously for the past 7 years and which was well infected with the root rot organisms. The fertilizer in the drill was applied just before planting, that applied on top of the drill being put on just before the peas came through the ground. The lime and sulfur were applied broadcast and raked under just before planting. These plots were examined a number of times during the growing season, but no effects or root rot could be observed from any of the treatments.

On plot 9, one of those receiving fertilizer, with nitrogen as nitrate of soda, applied in the drill, germination was slow, and there was some seed rot. Plots with the fertilizer applied on top of the row had a better general appearance early in the season than where the fertilizer was applied in the row, and plots with no fertilizer were slightly

TABLE 20

Treatments on Fertilizer, Sulfur and Lime Plots

Plot No.	Fertilizer	N-source	Amount per Acre	Method of Application
			lbs.	
1 and 9	4-8-5	Nitrate of Soda	500	In drill at planting time
2-10	4-8-5	Sulfate of Ammonia	500	In drill at planting time
3-11	0-8-5	.....	500	In drill at planting time
4-12	None	.....	.....	.....
5-13	4-8-5	Nitrate of Soda	500	On top of drill after planting
6-14	4-8-5	Sulfate of Ammonia	500	On top of drill after planting
7-15	0-6-5	.....	500	On top of drill after planting
8-16	None	.....	.....	.....
17, 18	Hyd. Lime	.....	500	Broadcast
19, 20	Hyd. Lime	.....	1000	Broadcast
21, 22	Sulfur	.....	300	Broadcast
23, 24	Sulfur	.....	600	Broadcast
25	None	.....	.....	Broadcast

yellow, but aside from these growth differences there were no effects of the fertilizer treatments, the root rot developing the same on all plots. The lime and sulfur applications also failed to influence the amount or development of root rot.

Planting Depth

Some growers practice deep planting and maintain that this method reduces losses from root rot. To test this theory, plantings at different depths were made in Cumberland, Burlington and Camden Counties. In Cumberland County the plots were $^1/_{200}$ acre in size and were run in duplicate; in the other 2 counties each plot consisted of one 20-foot row and was duplicated. The planting depths tested were as follows:

1. Ground level planting, covered with slight ridge.
2. 1-inch drill covered level.
3. 2-inch drill covered level.
4. 3-inch drill covered level.
5. 4-inch drill covered level.
6. 4-inch drill seed covered 1 inch.
7. 5-inch drill seed covered 1 inch.
8. 6-inch drill seed covered 1 inch.

In plots 6, 7 and 8 the soil was drawn in after the peas were up, the drill finally being completely filled. In 2 of the counties 1 plot of each planting depth was on medium or light ground and the duplicate plot on a heavier soil, thus giving a comparison of soil types at the same time.

Careful examinations made at intervals throughout the season failed to show any effect of planting depth on development of root rot. Very shallow plantings showed somewhat more sun scald and Ascochyta blight, but the roots showed 100 per cent rot in all cases.

Resistant Strains Test

In a test of 40 varieties of peas, the results of which have already been reported (New Jersey Agricultural Experiment Station Report, 1923), it was shown that while all these varieties were susceptible to root rot a few were able to yield a fair crop in spite of a severe root rot infection. Of these slightly resistant varieties, the Sutton's Ideal and the World's Record were especially satisfactory, yielding better than the standard New Jersey varieties, and having equally good or better market qualities. As a result of this favorable showing in the variety test in 1922, these 2 varieties have been given a field trial by a number of growers during the past 2 years, and in every case have given better results than the varieties usually planted. The large green pods, early maturity, and ability to yield fair crops on root rot soil, have brought these varieties into favor wherever they have been used.

Since even the most favorable varieties are very susceptible to root rot and in certain soils may even fail to produce pods, efforts have been made to secure by individual vine selection strains sufficiently resistant to yield good crops on root rot infected soil. Fifteen such selections were tested on a severely infected soil in Camden County this year. Of these, 15 New Jersey strains, several from the Alaska variety, 2 from Pilot and 1 from World's Record, showed somewhat higher degrees of resistance than the commercial lots of these varieties. The progeny of these prospective strains, with additional selections made this year, will be tested further on root rot soil.

In addition to these New Jersey selections, which are in the first year of their pedigreed history, a number of strains selected and bred for root rot resistance in other states were tested in various root rot sections of New Jersey this year. Eleven pedigreed strains bearing the numbers $\frac{26.14}{15.1\text{–}16.2}$, $\frac{52.15}{16.6\text{–}17.2}$, 13.102, 17.106, 31.14, 10.452, 11.15, 69.16, 18.14, 19.14 and 83.16 were secured from the Wisconsin Agricultural Experiment Station. Nine strains bearing the letters A, B, C, F, G, H, I, J, K, were obtained from the United States Department of Agriculture, and one strain, No. 418, from the Maryland Experiment Station. The Wisconsin selections were tested in Burlington, Cumberland, Camden and Middlesex Counties, and the Washington and Maryland selections in the 3 last-named counties. In the Middlesex County plot the soil was free from root rot and all selections remained free from the disease. In Cumberland County the test plot was on soil which had been planted in peas repeatedly during the past 7 years and root rot was general. But in spite of the presence of the disease, good yields were obtained and even the very susceptible Alaska yielded a heavy crop. On this plot the Washington selections made a more vigorous and more uniform growth than commercial Alaskas and showed less injury from root rot. Five of the Washington strains yielded the same or less than Alaska, while 4 strains gave from 15 to 30 per cent greater yield and seemed to be well suited for the New Jersey canning sections. The Maryland selection (418) gave a poorer yield than Alaska and was equally subject to root rot.

Of the Wisconsin selections all the late maturing strains of the Horal and Horsford type proved somewhat resistant to root rot, but for other reasons were less satisfactory than Alaska.

The early Wisconsin selections of the Alaska type yielded less than the commercial Alaska and showed no indication of root rot resistance.

On the Burlington and Camden County plots, where root rot was extremely severe, the common Alaska, the Washington and Maryland selections and the Wisconsin selections of the early Alaska type (Wis. Ped. 18.14 and 19.14) died before the first pods were mature. A late Alaska strain (Wis. Ped. 13.102) matured a fair crop, and an Early Sweet (Wis. Ped. 69.16) gave a good yield. No immunity to root rot infection, however, was shown in either of these, 100 per cent disease being present in both cases. The selections from the Horal (Wis. Ped.

1135). Horsford (Wis. Ped. 10452 and 17.106) and Badger (Wis. Ped. 31.14) developed root rot much later than the Alaska type and showed a much milder form of the disease, though every plant was infected. These thick-stemmed, dark green varieties seemed to show a slight tendency to overcome the effects of root rot by secondary thickening of the cortex of the underground part of the stem. Although root rot caused less injury on these late strains, another trouble developed which was even more destructive. About 50 to 75 per cent of the plants were severely dwarfed and all the lower leaves yellowed and died before blossoming time. An examination showed that the vascular system of the lower stem was reddish and contained a species of Fusarium. This same trouble has been occasionally observed on the dwarf varieties of peas used in some sections.

Of all the selections above discussed, none showed sufficient resistance to yield favorably on soils heavily infected with the root rot organism. The individual vine selections of the World's Record and Pilot varieties, which yield fair crops in the root rot sections, have given the best showing, and give hopes for future success for New Jersey selections. The selections made in other states either show no appreciable resistance under New Jersey conditions, or are unsatisfactory for the pea section of this state. The work with New Jersey selections will be continued, and further tests will be made with strains developed for resistance in other states.

POTATO SCAB CONTROL STUDIES IN 1923

J. G. Gaines

Tests with sulfur for the control of potato scab were continued this year. In the previous studies the sulfur used was of a uniform fineness, approximately 200 mesh. Since the use of sulfur has been generally adopted by the growers, the question has been raised as to the possibility of using a coarser mesh in order to reduce the cost of the treatment and at the same time secure the desired control of scab. A comparison was made of three different grades of sulfur, namely, 200, 80 and 20 mesh. Previous investigations at this station have shown that an application of 300 to 500 pounds of sulfur per acre gave satisfactory control of scab. In applying the smaller amount, however, many growers have experienced difficulty in securing a uniform distribution. In view of this fact, tests were conducted to determine the possibility of incorporating the sulfur with some material which would act as a carrier and at the same time not interfere with its fungicidal value. For this purpose rock phosphate was used.

Experiment in Cooperation with Elbert Newkirk, Bridgeton

Irish Cobbler Variety

This experiment was conducted near Bridgeton on a sassafras loam soil that had consistently produced severely scabbed potatoes. The pH values of extracts from soil samples taken from the field at the time of planting were fairly uniform, ranging from 6.6 to 6.9. In this test a comparison was made of 3 grades of inoculated sulfur, 200, 80 and 20 mesh, applied at the rate of 500 pounds per acre, and a sulfur-rock phosphate mixture applied at the rate of 400, 800 and 1,200 pounds per acre, equivalent to 200, 400 and 600 pounds of sulfur, respectively. Each treated plot of $^1/_{40}$ acre size with its check was duplicated. Treatments were applied April 10 and the crop was planted the same day. No difference could be noted in the vine growth on the different plots at any time during the growing period.

At harvesting time the tubers from each plot were classified into one of three groups—clean, salable scabby and unsalable scabby. Composite soil samples from each plot were also secured for the purpose of determining the change in soil reaction. In table 21 is presented the average percentages of clean, salable scabby and unsalable scabby tubers, together with the hydrogen-ion exponents of soil extracts from each plot. It will be noted that in no plot was there an outstanding control of scab. It will be observed, however, that by decreasing the size of sulfur particles there was a slightly increased control, and that with each increase in the amount of sulfur-rock phosphate mixture employed there was a corresponding decrease in the number of scabby tubers. In each instance an increase in scab control is accompanied by a lower pH value of the soil extracts. The above can be observed from the columns in table 1 showing the increase or decrease of clean, salable and unsalable tubers, yield in bushels per acre, and pH value of the soil extracts from the treated plots as compared with the checks.

The pH value of soil extracts from plots receiving 200-mesh sulfur was lowered 0.83 against a reduction of 0.55 and 0.08, respectively, where the 80 and 20-mesh sulfur was used. It therefore appears that the greater efficiency of the finely ground sulfur in controlling scab was due to the lower soil reaction which it induced.

Of the 3 amounts of the sulfur-rock phosphate mixture used, the 1,200-pound application gave 4.0 per cent of clean tubers than did 800 pounds, and 12.2 per cent more than 400 pounds. The 500-pound application of sulfur reduced the soil reaction 0.83, while 600 pounds contained in the 1,200-pound application of the sulfur-rock phosphate mixture reduced the soil reaction 0.78, and both treatments gave practically the same control of scab.

In any of the forms applied, sulfur had practically no influence on yield. Very slight increases were observed on the treated plots, but such small differences are entirely negligible.

TABLE 21

Influence of Size of Sulfur Particles and Sulfur-rock Phosphate Mixture on the Development of Scab

TREATMENT PER ACRE	Clean Tubers		Salable Scabby		Unsalable Scabby		Yield Per Acre		Soil Reaction	
	Clean tubers	Increase or decrease	Salable scabby	Increase or decrease	Unsalable scabby	Increase or decrease		Increase or decrease	pH values	Increase or decrease
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*bu.*	*bu.*		
Check	13.0	....	73.1	....	13.9	....	122	....	6.7	....
500 lbs. 200-mesh sulfur	31.5	+18.1	62.2	—10.6	6.3	— 7.5	126	+ 3	5.8	—.83
500 lbs. 80-mesh sulfur	20.8	+ 7.0	71.1	— 1.4	8.1	— 5.6	131	+ 6	6.0	—.55
500 lbs. 20-mesh sulfur	18.5	+ 4.3	71.2	— 1.0	10.3	— 2.7	129	+ 3	6.4	—.08
Check	14.6	....	71.9	....	13.5	....	127	....	6.4	....
400 lbs. sulfur-rock mixture	15.4	+ 1.8	76.3	+ 5.0	8.3	— 6.7	127	+ 4	6.4	—.12
800 lbs. sulfur-rock mixture	22.7	+10.0	71.4	+ 0.7	5.9	—10.6	128	+ 8	6.3	—.35
1200 lbs. sulfur-rock mixture	25.7	+14.0	68.4	— 1.8	5.9	—12.1	127	+10	6.0	—.78
Check	10.8	....	69.6	....	19.6	....	113	....	6.9	....

Since it has previously been shown by investigators at this station that the amount of rainfall during the growing season has considerable influence on the prevalence of scab, it might be well to make a statement here of the weather conditions during the summer of 1923 The entire growing season was dry, exceptionally so during the months of May and June. The rainfall in this part of the state from April to September was 19.26 inches, or 4.44 inches below normal for the 6-month period, while the rainfall during May and June, the time when tubers were developing, was 4.86 inches below normal for the 2-month period. It has previously been shown that sulfur is not so effective in controlling scab in dry as in wet seasons. This fact might be an explanation for the limited control of scab observed in this experiment.

Experiment in Cooperation with John Hickish, Salem, N. J.

Irish Cobbler Variety

This experiment was identical to the one conducted at Bridgeton, and since the test was located only about 6 miles distant, it was subjected to approximately the same weather conditions. This soil is somewhat lighter than that of the above experiment and had produced more severely scabbed potatoes. The initial reaction of the soil, however, was somewhat lower than that in the previous experiment, ranging from 6.2 to 6.4. Treatments were applied April 11 and the crop was planted immediately afterward.

In this test less than 1 per cent of the total tubers produced on the check plots was free from scab, while 82.2 per cent to 85.3 per cent were unsalable scabby. The results are given in table 22.

In comparing the applications of 200, 80 and 20-mesh sulfur, it is observed that the fine mesh resulted in a reduction of 49.4 per cent in the number of unsalable tubers as against 38.3 per cent and 22.1 per cent for the medium and coarse sulfur, respectively. A decrease in pH of 0.6 resulted from the application of finely ground sulfur while the coarser forms reduced the pH 0.3.

From a study of table 22 it will be noted that 500 pounds of regular mesh sulfur reduced the soil reaction 0.6 and decreased the unsalable tubers 49.4, while 600 pounds of sulfur in the same amount of rock phosphate also reduced the soil reaction 0.6, but reduced the unsalable tubers 62.0 per cent. According to the results of investigations at this station, sulfur oxidation is hastened in the presence of rock phosphate, but more sulfur must be oxidized to bring about a given reduction in pH. If the above is equally as true in the soils used in this investigation, then it is quite probable that the soil reaction, following the use of sulfur-rock-phosphate mixture, reached its lowest point sooner than where sulfur alone was used. In such an instance a more rapid and complete oxidation of sulfur is induced, while the rock phosphate present would have a tendency to bring the reaction back

TABLE 22

Influence of Size of Sulfur Particles and Sulfur-rock Phosphate Mixture on the Development of Potato Scab

TREATMENT PER ACRE	Clean Tubers		Salable Scabby		Unsalable Scabby		Yield Per Acre		Soil Reaction	
	Clean tubers	Increase or decrease	Salable scabby	Increase or decrease	Unsalable scabby	Increase or decrease		Increase or decrease	pH values	Increase or decrease
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*bu.*	*bu.*		
Check	1.3	....	15.4	....	83.3	....	72.9	....	6.2	....
500 lbs. 200-mesh sulfur	18.5	+17.4	47.9	+32.0	33.6	—49.4	80.3	+6.7	5.6	—.6
500 lbs. 80-mesh sulfur	9.5	+8.6	46.0	+29.6	44.5	—38.3	87.6	+13.3	5.9	—.3
500 lbs. 20-mesh sulfur	4.9	+4.3	34.7	+17.8	60.4	—22.1	76.2	+1.2	5.9	—.3
Check	0.4	....	17.4	....	82.2	....	75.7	....	6.2	....
400 lbs. sulfur-rock mixture	10.8	+10.5	49.7	+33.0	39.5	—43.5	66.6	—7.3	5.9	—.3
800 lbs. sulfur-rock mixture	18.2	+18.0	25.9	+36.8	28.9	—54.9	77.2	+5.2	5.7	—.5
1200 lbs. sulfur-rock mixture	27.5	+27.4	50.0	+34.6	22.5	—62.0	78.0	+7.8	5.6	—.6
Check	0.0	....	14.7	....	85.3	....	68.4	....	6.2	....

TABLE 23

Influence of Inoculated and Uninoculated Sulfur and Inoculated Su lfur-rock-phosphate Mixture on the Development of Scab

TREATMENT PER ACRE	Clean Tubers		Salable Scabby		Unsalable Scabby		Yield Per Acre		Soil Reaction	
	Clean tubers	Increase or decrease	Salable scabby	Increase or decrease	Unsalable scabby	Increase or decrease		Increase or decrease	pH values	Increase or decrease
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*bu.*	*bu.*		
Check	13.4	....	77.8	....	8.8	....	92.0	....	6.3	....
300 lbs. uninoc. sulfur	23.8	+12.7	76.2	—5.4	0.0	—7.2	119.3	+26.6	6.3	.0
300 lbs. inoc. sulfur	23.4	+14.5	76.6	—8.8	0.0	—5.6	132.7	+39.3	5.8	—.5
Check	6.7	....	89.3	....	4.0	....	94.0	....	6.3	....
600 lbs. uninoc. sulfur	35.7	+28.7	64.3	—23.8	0.0	—4.8	151.7	+38.4	5.8	—.44
600 lbs. inoc. sulfur	45.7	+38.2	54.2	—32.8	0.3	—5.4	153.4	+20.8	5.3	—.88
Check	7.6	....	85.9	....	6.5	....	152.0	....	6.1	....
600 lbs. sulfur-rock mixture	36.6	+29.9	62.7	—21.9	0.7	—8.0	138.0	—5.4	5.6	—.47
1200 lbs. sulfur-rock mixture	51.6	+45.8	48.4	—35.0	0.0	—10.8	120.0	—14.7	5.5	—.53
Check	4.9	....	82.1	....	13.0	....	126.0	....	6.0	....

toward the initial point sooner than otherwise. Just how much buffering effect the rock phosphate has in the soil, and how much influence it has directly or indirectly, is not known. It is apparent from these two experiments, however, that sulfur mixed with finely ground rock phosphate gives as good control of scab as sulfur alone.

No noteworthy differences were noted in the yields from any of the plots. Apparently none of the treatments had any influence, although indications were in favor of a very slight increase.

Experiment in Cooperation with Jacob Lopatin, Freehold, N. J.

Giant Variety

This experiment was conducted on a sassafras loam soil that in 1922 produced a crop which was practically unsalable because of scab. Comparisons made between two applications, 300 and 600 pounds per acre, of inoculated and uninoculated sulfur and between two amounts, 600 and 1,200 pounds per acre, of the sulfur-rock-phosphate mixture.

It is generally known that the Giant variety is not so susceptible to scab as is the Irish Cobbler. This doubtless explains the fact that practically none of the crop was unsalable on any of the plots, including the checks. In classifying the crop at harvesting time, all tubers entirely or almost entirely covered with scab lesions, although only skin deep, were considered as unsalable, while the other groups were classified as before.

The average percentages of the 3 classes of tubers harvested from each plot with its duplicate are given in table 23. It will be noted there is practically no difference in amount of scab between the plots receiving 300 pounds of inoculated and uninoculated sulfur, while 600 pounds of the former resulted in 9.5 per cent more clean tubers than the same amount of the latter. However, 300 pounds of the uninoculated increased the number of clean tubers 12.7 per cent, and apparently did not reduce the pH of the soil extract. An equal application of the inoculated increased the clean tubers 14.5 per cent and decreased the pH value 0.5. From a consideration of the plots receiving 600-pound treatments per acre, it is apparent that an increase in control is accompanied by a decrease in soil reaction.

In comparing the different amounts of inoculated and uninoculated sulfur, it is seen that 300 pounds of the former reduced the pH 0.5, while 600 pounds of the latter reduced the pH 0.44, but produced 14.3 per cent more clean tubers than the former. Such discrepancies yet await a satisfactory explanation. However, since the plots covered a total area of almost an acre, and since the plots immediately adjoining one another gave comparable results, it is possible that the experimental error may have been large enough to account for such discrepancies. Although decreasing the pH of the soil decreases scab-

bing, it is not possible to assume that the amount of scab in the crop will always compare perfectly with the pH values.

The inoculated sulfur-rock-phosphate mixture gave results comparable to those obtained in the 2 previous experiments, in that an application of 1,200 pounds gave better results than 600 pounds. The sulfur-rock mixture also compared favorably with inoculated sulfur, giving a slightly greater control, while 300 pounds of sulfur in the mixture gave as satisfactory results as 600 pounds of uninoculated sulfur. Again, it was observed that the sulfur-rock mixture gave better control than equivalent amounts of sulfur alone, and did not reduce the soil reaction as much as did the latter. The 600-pound application of inoculated sulfur reduced the soil reaction 0.88, while an equal amount of inoculated sulfur in the rock phosphate carrier decreased the reaction 0.53 and gave as good control as the former.